Uncharted Terrains

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Essays on Science Popularisation in Pre-Independence India

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Satpal Sangwan is with the History of Science Faculty at the National Institute of Science, Technology and Development Studies, New Delhi. His major research interests include the interface of science, environment and imperialism, and the social construction of scientific knowledge. He has published *Science, Technology and Colonisation* (1991), and has co-edited *Nature & The Orient* (OUP, 1997).

VIGYAN PRASAR
An Introduction

Vigyan Prasar (VP) was set up by the Department of Science and Technology, Government of India, as an autonomous registered Society in 1989 for taking up large-scale science popularisation tasks. Its broad objectives may be summarised as follows:

To undertake, aid, promote, guide and co-ordinate efforts in popularisation of science and inculcation of scientific temper among the people and to increase the knowledge, awareness and interest about science and technology among all segments of the society.

To provide and promote effective linkages on a continuing basis among various scientific institutions, agencies, educational and academic bodies, laboratories, museums, industry, trade and other organisations for effective exchange and dissemination of S&T information.

To undertake development of materials—audio, visual, audio-visual and printed—methods and modes of communication, so as to enable the masses to better understand, appreciate and comprehend abstract scientific principles and practices.

To organise research work, courses, workshops, seminars, symposia, training programmes, fairs, exhibitions, film-shows, popular discussions, street plays, quizzes, song-dance-dramas etc., in furtherance of the objectives of the Society.

After its establishment Vigyan Prasar remained dormant for a few years. Only in 1994 some activities could be taken up in right earnest. One among the first few programmes initiated by VigyanPrasar was the 'Ready-to-Print' Science Page project. The idea was to prepare a well laid-out newspaper-size page with one or two features and several smaller items on scientific and technological (S&T) developments taking place in India, appropriately supported with photographs, illustrations, graphics etc., and to supply it to newspapers to carry as it is. Initially, such pages in Hindi and English were planned for release once a month. Subsequently, a children's page, science pages in other major Indian languages and a feature packet service were also added. Today, these pages are being carried once or twice a month by more than 30 editions of some 20 newspapers spread all over the country. In fact, today Vigyan Prasar's are the largest circulated science pages in the country. The combined print order of all these newspapers exceeds 2.5 million copies. These pages have led to fresh demands for enhanced

science coverage in other newspapers.

Vigyan Prasar's publications programme is gradually taking shape. A number of important series has been launched; some more are planned. The first major English publication brought out by Vigyan Prasar, viz., *"Memoirs of Ruchi Ram Sahni: Pioneer of Science Popularisation in Punjab,"* under its series on Pioneer Science Popularisers in Pre-Independence India has generated positive awareness among science communicators and enthused researchers about the need to unearth other such personalities in other parts of the country. Already names of a number of individuals who did pioneering work in the field of science popularisation in pre-Independence India have come to light.

Popular science classics written by Great Masters in the past, which have inspired generations of students of science, are no longer seen in the hands of our younger generation. This is not because these books have gone out of context, but because they are no longer available. Vigyan Prasar under its Popular Science Classics series intends to reprint these books and bring them out in low-priced affordable editions so that more and more children can have them. Already two such classics (Michael Faraday's *Chemical History of a Candle* and C.V. Boys' *Soap Bubbles And the Forces Which Mould Them)* and there different language versions viz., Marathi, Tamil and Hindi have also been brought out. George Gamow's "One, Two, Three... infinity: Facts and Speculations of Science" has also been translated into Hindi.

Inspired by the focal theme for the National Science Day-1995, viz., 'Science for Health', Vigyan Prasar initiated a Health Series. Under it publications on all common diseases, along with possible management of their curative and preventive aspects would be brought out. The first three titles on *Sexually Transmitted Diseases, Asthma and Jaundice,* have already been released. More titles including books in other languages are also coming out.

Under its series of Monographs on India's Scientific Heritage Vigyan Prasar intends to bring out publications on specific science and technology areas in which India's contributions have stood the test of time, as also have made an impact on modern-day science. The first monograph in the series, *'The Rustless Wonder: A Study of the Iron Pillar at Delhi'* was released on 30 January 1997. The second volume *'Where Gods Come Alive : A Study of the South*

Indian Bronze Icons 'would be going to the press shortly.

Some of the other publications brough out by Vigyan Prasar are My Friend Mr. Leakey, & Everything Has a History by J.B.S. Haldane; Development and Valuation of Urban Properties, by P.K. Ratho, Alternatives to Pesticides in Tropical Countries by A.T. Dudani.

A new series on Environmental Hotspots was launched by Vigyan Prasar recently. The first volume brough out under the series is on Tehri Hydro-Electric Project and Narmada Valley Project.

Total Solar Eclipse of October 24, 1995, provided Vigyan Prasar a rare opportunity to organise a country-wide awareness campaign, aimed at dispelling age-old myths and superstitious beliefs related to eclipses, and to develop among people an urge to learn about their known scientific aspects. Vigyan Prasar jointly with the National Council for Science and Technology Communication (NCSTC) organised a number of activities:

i. Telescope-making workshops for students and teachers.

ii. Development and production of books, a total solar eclipse chart and an activity kit for children.

iii. Production of several video films and their telecast.

Vigyan Prasar conceptualised and implemented a novel idea for ensuring that people did come out and watch the total solar eclipse. It circulated a total solar eclipse pledge. People in thousands from all corners of the country sent in signed pledges. Many individuals and voluntary agencies got these pledges translated into regional languages on their own and distributed the same in large numbers. All this led to a chain of activities throughout the country. The efforts made by VP, NCSTC and other agencies created a situation where millions of people came out and watched the spectacular event. This was a unique experience and made Vigyan Prasar's name a household word throughout the country.

Under its audio-visual programme, Vigyan Prasar developed a set of video films and several radio programmes on the occasion of the total solar eclipse of 24 October 1995. This event-based effort was enormously satisfying for the VP family and generated a very good response from the public at large.

Vigyan Prasar has recently begun building an Information System called VIPRIS — acronym for **VI**gyan **PR**asar **I**nformation **S**ystem —

to meet a long-standing demand from different quarters, particularly the science communicators, to establish a repository of background data and information on various aspects of S&T which would be accessible easily. The computerised system would be built on a modular basis, and aim to meet the information needs of science communicators of all kinds.

At this stage, under VIPRIS, we have a fortnightly clippings service, an electronic bulletin board service (BBS), weekly science news on the radio, and had two pages daily on Doordarshan's teletext service till it was closed and Several other products and services including training, generation of data bases on different subject areas etc., in the making.

The first phase of the database on " Environment & Safety Laws: Regulations & Guidance Documents " has been completed. VP launched its Homepage on the Internet on 12 September, 1996. An online electronic popular science magazine 'ComCom', was launched soon after as part of the Homepage. The other sections of the Homepage are, About Vigyan Prasar , Daily Weather Report, Sky map of the days/month, links with other related homepage, S&T vacancies in India, News from S&T laboratories, S&T databases etc. It has provision for Hindi HTML and support for Web browsers / users to download the Hindi Plug-in and install it in their system. It has also a discussion forum with support to display and keep visitors' view.

Taking note of the growing propularity fo the multimedia mode of presentation Vigyan Prasar has launched a programme to bring out CD-ROMs on different aspects of S&T. The first two CD-ROMs are based on its recent publication viz., The Rustless Wonder: A Study of the Iron Pillar at Delhi" and "Mad, Mad, Mad Cow: An Overview of the Mad Cow Disease. The other two CD-ROMs under development are on `Eclipses' and `Living Space and Structures'.

A number of video programmes has also been produced. Recent ones among them have been on "Herbal Petrol" and "Comets" (in connection with the coming of the comet "Hale-Bopp"). Several other programmes are under production.

Vigyan Prasar and All India Radio Bhopal jointly produced "Paryavaran Calling", a 26-part fortnightly phone-in-quiz radio serial. This programme was aimed at inculcating scientific attitutde and awareness about all aspects of environment among the masses. The phone-in as well as postal winners were taken on a Nature places of

Madhya Pradesh. Similar kinds of programmes are to be launched with All India Radio, Chennai and Guwahati.

Vigyan Prasar has also produced audio-cassette sets of the 108-part radio serial 'Manav Ka Vikas' (jointly produced by the NCSTC and All India Radio) in 18 Indian languages.

Vigyan Prasar has initiated programme to establish science clubs in different parts of the country under the aegis of VIPNET. Efforts are also on to popularise HAM-RADIO.

This is not all. Vigyan Prasar does many other things. But for now this should suffice.

Narender K. Sehgal
Director
Vigyan Prasar

Preface

Five years ago Vigyan Prasar had brought out its first major publication, "Memoirs of Ruchi Ram Sahni: Pioneer of Science popularisation in Punjab". It was an account of little-known facts and information about the life, science popularisation efforts and scientific work of Ruchi Ram Sahni — an unsung hero of Indian science from the pre-independence era. The book was preceded by a two-part article on Ruchi Ram Sahni by the undersigned in *NCSTC Communications* (November 1991 and January 1992 issues). How we came to know about the existence of the original manuscript has been described in my Preface to the book. We find that the means adopted by Ruchi Ram Sahni for communicating science to the masses are still very relevant, as one reviewer of the book wrote : "And it may not be an exaggeration to say that they (Ruchi Ram's efforts) remain unique to this day considering that the post-independence Indian scientific community, by and large, accorded little importance to communicating science to the public..." Keeping this in view and also taking note of the overwhelming response from many different quarters Vigyan Prasar initiated the following activities.

1. Organisation of seminars in different parts of the country on a broad theme: "Science Poularisation Efforts in Pre-independence India". The idea was to identify more individuals like Ruchi Ram Sahni in other parts of the country.
2. Translation of the book in different Indian languages. (We have already brought out three language versions viz. Hindi, Marathi and Punjabi).
3. Bringing out suitably edited volumes on select popular science writings from the period 1850-1950 in different Indian languages. (The compilations have been completed in Bengali and Hindi).

The present volume is an outcome of the first activity. Earlier we had brought out a volume based on the talks presented on science poularisation efforts in Hindi in pre-independence India during the seminar held at Allahabad (27-28 January 1996). The present volume is based on papers presented in three seminars organised at Chandigarh (11 March 1995), New Delhi (21 April 1995) and Calcutta (12 May 1995)

Narender K. Sehgal

New Delhi
January 06, 2000

Introduction

> I consider it to be the duty of scientists not only to. occupy themselves with improvements and discoveries within the confines of their specialities, not only to devote themselves to the investigation of the particulars, but to make available to society as a whole the important general result of their particular studies, and to help disseminate scientific learning widely.[1]
>
> *Ernst Haeckel*

> One addicted to science....., must, share his pleasure with others irrespective of their social or other privileges and accomplishments.[2]
>
> *Ramendrasundar Trivedi*

> I am not interested in popularising science for those who know nothing: enough is done for them, nor for those whose interest is so small and so fickle that they have to be entertained all the time. The aim is to educate the scientists themselves–to explain to them points of view different from their own.[3]
>
> *George Sarton*

The discourse of recounting the past, any dabbler in history reading would tell us, has continuously been influenced by shifting intellectual perceptions and social priorities. These shifts, which are much more explicit when a discipline is in the making, help the discipline itself. The social history of science, for example, has for a long time been interrupted and shaped by conflicting claims of the 'internalist' and 'externalist' camps. The first generation of historians of science, having their roots in science, somehow got interested in the classical texts, read them and offered insights in the intellectual contents of these texts, They are there, though in oblivion, to disparage the 'cruddy economic interpretation of scientific projects' which offers anything but 'science'.[4] There is yet another category of hard-core 'scientist' historians who would even reject the socalled 'internal' history of, say, chemistry by experts 'with their fuzzy background in alchemy and medicine', They would demand studying the 'technical parts of the edifice in more details, the technical parts which constitute much of the prehistory of the whole marvellous structure of thought and civilisation'.'Science', the argument goes, had inner compulsion which are more central to its being than the environment in which it flourishes. Social influences are there but they are less unique and less important than the inverse[5]. But given the fact that science or scientific knowledge operates in a given cultural and social space the social history of science looks for new audiences, problems and methods. 'Renewed interest in the creative process and the diffusion of ideas as social processes provides some kind of fresh air in an otherwise depressed academic market'.[6] The social history of science is therefore, ' here

to stay, sustained not only by historical concerns but by contemporary interest in the relationship between social, economic and political changes wrought by, and reflected in, modern science and technology.'

The hierarchy of social, economic and political factors affecting the construction and deconstruction of scientific knowledge has further created a divide in the agenda of social history of science. The discipline largely conceived as 'civilising' mission to 'provide the primary record of civilisation',[8] is thus constrained by the dichotomy between 'economic' and 'cultural' modes of interpretation. The dichotomy assumes that science is pursued either for reasons of economic gain, or for social and cultural reasons'.[9] These and other functional roles of scientific knowledge reoccur uninterruptionally in common narratives of the scientific and technological projects launched by the colonial powers in their acquired lands. The empire-science problematic has only concentrated on the hegemonic role of science on the periphery—as 'tools' of empire in a vulgar language of aggression and as a 'mask of conquest' in somewhat sober, liberal terms. Least to say of technology which served imperial demands of expansion and appropriation, apparently genuine attempts to popularise western science, are seen as part of a strategy 'for penetration and control'[10]. Social history of colonial scientific discourse will, however, be incomplete if we continue to treat science as a purely political 'tool' in the armoury of colonial state and a cultural mask used by the colonial scientist to hide his real intention of colonising the local discourse. The heterogeneity of the discourse, both at institutional and intellectual levels, is one area that needs to be probed'[11].

Given the fact that more than two-thirds of the world population has been territorially and culturally run over by one or the other colonial (European) power during the last couple of centuries (coinciding with their marvellous achievements in the fields of science around the same time) the empire-science problematic, however, promises to reveal some of the more interesting episodes in the making of science. An area which has escaped the attention of the architects of 'colonial' science is 'vernacularisation' of western scientific knowledge. In the framework of the diffusionist model, the direction of science on the periphery was shaped by the growing demands of imperialism and the expansion of personal and institutional interests in the scientific projects. Social mobilisation of science which was further accelerated by the growing public appreciation and appropriation of scientific knowledge in the west is conspicuous by its absence in the whole

discourse. Although a few analysts of the centre—periphery model of science have now shifted their attention to the relevance of social settings on the periphery,[12] public understanding of science beyond the 'metropolis' is still missing from the dominant agenda. The emerging debate on the theories of science appropriation opens yet another front for the social historians of science.

One major factor for the lack of interest in the historical roots of the Public Understanding of Science (PUS) agenda on a colonial periphery like India is an apparent cultural divide between the knowledge producers (the rulers) and the recipients (the ruled). For most of their time on the periphery the colonial (European) scientists continued to address scientific peers residing back home and a small yet effective community of the Europeans on the periphery.[13] But still colonial scientific discourse might not be dismissed as a oneway traffic, an all white affair, where, once removed from the mainstream, people with fuzzy background in science found a repose in scientific adventures. A more serious study will require further analysis of the interactive process through which scientific knowledge travelled from the domain of a cultural elite to further down the bottom of a cultural hierarchy.

An outline of the emerging quest for knowledge sharing within a colonial framework may then be constructed on a three-tier model. At the top we may find a cumulative efforts among the widely scattered community of transplanted Europeans to familiarise their own ranks with the scientific knowledge and technological projects. At middle levels we notice some understanding on the part of the colonial to share this infiltrated knowledge with local communities. This genuine sympathy would later be replaced by some constructive programme on the part of indigenous' elite to popularise new knowledge among their own identified ranks.

Conventional approaches to science popularisation envisage the existence of two intellectually separated human categories: knowledge producers and knowledge gatherers. At the face of it the very idea of communicating knowledge exudes a missionary, benevolent agenda where men of superior intellectual capacity and vision take upon themselves the task of uplifting the intellectual standard of an intellectually subordinate class. Essentially, therefore, popularisation is neither viewed as part of a knowledge production process nor as an act of appreciation of the knowledge pool of the recipients. It is only in recent years that the level of debate on the forms and functions

of popularisation has shunned the stereotypes.[14] It is now being recognised that the image of scientific ideas and technological projects as social processes rests on the inter-dependence of the two categories. In order to appreciate the social roots and social impact of scientific knowledge it is necessary to admit that a wider society existed beyond the known constituency of science. Their appreciation, approbation and appropriation of the scientific knowledge was as important as its generation.[15]

The essays presented here address the various forms of popularisation within the compelling demands of colonialism. Our book opens with two theme papers spelling out the evolutionary model and conceptual boundaries of the PUS programme in a colonial context. In the first paper Satpal Sangwan draws our attention to the 'wasteland' area lying between the 'diffusionist' and the 'imperialist' models. Tracing the historical roots of openness in science and a cultural context for the emerging public appreciation of scientific knowledge he deconstructs the myth that 'colonial' science was culturally located outside the public domain. On the contrary the very exploratory nature of colonial science, as Sangwan suggests, was itself a reminder of the fact that science was no longer the domain of a privileged class. Besides, funding of scientific societies, societies for the promotion of useful knowledge, launching of scientific journals, public display of collections from the natural world and technological marvels, and a series of popular lectures on science arranged by various formal and informal clubs, they all typified the broadening of the base of science.

The performer-audience syndrome in colonial.science further leads to the major area of vernacularisation of western knowledge system. The whole process was premised on the basic need of bringing down science from the heaven to the earth. In the second theme paper Dhruv Raina addresses the problematic of translation. Though translation espouses the whims of a civilising mission Raina gives more space to the social and intellectual determinants of translation. Further underlining the efficacy of text-books in the domestication of scientific knowledge Raina recaptures the sensitivity with which the autodidacts would have negotiated the problem. In their endeavour to remodel the new knowledge, they did not take their back on traditional knowledge either. In this context it is worth consideration if P.C. Ray's project of relocating the annals of Hindu chemistry was situated to draw attention to the importance of traditional knowledge and the role this science could play in the progress of industry, mechanics, physics, agriculture and physiology.

Having introduced the emerging agenda for studies on science popularisation, both from historical and conceptual standpoints, we further move to the demographic variations that underlined the plurality of the discourse. What we notice in the process is the existence of a multilayered periphery. With Bengal having experienced the first cultural renaissance in the 19th century science had captured the imagination of the *bhadraloks,* the emerging pillars of a 'gentlemanly' culture. Launched by philanthropists like Rajendralal Mitra (RLM) toward the mid-nineteenth century, science popularisation in Bengal was later adopted by men of literature and scientific pursuits. The four essays included in the second section not only give a chronological description of science popularisation in Bengal but also reproduces the changing forms of popularisation over one hundred years of colonial rule. The mid-nineteenth century mood is captured by Amitabha Ghosh in his narrative of the agenda set by RLM. Riding on the waves of enterprise which had earlier swept Bengal RLM sought to re-emphasise the Baconian model of science, science not for the sake of knowledge alone but for the material progress as well. The progress, however, could only be achieved after the clouds of ignorance were removed. This was followed by an all-out strategy to domesticate new knowledge through not only general debate and discussion on the utility of science but also through the medium of textbooks and popular science journals, all in Bengali language.

With public attention having been drawn to the utility of science by early philanthropists the late 19th century *bhadraloks* strived to vernacularise modern western science, manufacturing their own modernity. Bankimchandra's popular science essays created modern Bengali prose that could project science on the horizon. But the man who gave a new meaning to science popularisation, taking the discourse to the new professional heights, was Ramendrasundar Trivedi. Santanu Chacraverti recreates the intensity with which Trivedi had begun his mission at a tender age of twenty and how relentlessly he worked for nearly three decades simplifying some of the most complicated physical and astronomical phenomena, all in a highly readable and informative, popular style. To bring his point home, Trivedi drew examples from mythology, folklore and popular local traditions. Adding some kind of drama to an otherwise dull and scary subject he created a curiosity for science. His popular writings did not appeal to the common Bengali literate alone but also went on to inspire some of the best scientists ever produced by Bengal.

Towards the end of the 19th century Bengali honeymoon with

western ideals had run into problems with the British rejecting the Bengali entrepreneurs.[16] The end of the honeymoon led to the germination of national feelings (*swadeshi* in more revolutionary terms). These feelings found expression in many forms: in literature, in popular theatre, in the associations formed by land holders and the entrepreneurs. Sharing the same cultural values the men of scientific pursuits found it difficult to resist nationalist fervour. The founding of the Indian Association for the Cultivation of Science by M. L. Sircar in 1876, 'The Dawn Society' by Satish Chandra Mukherjee in 1902 and the National Council of Education in 1905, all symbolised the genesis of scientific nationalism in Bengal. The traits of this phenomenon in Bengal are reproduced by Chittabrata Palit with a further contextual analysis of the institutional form of popularisation.

The shift to institutional form of popularisation further consolidated the ranks of popularisers. There was a further shift in the interests of popularisers with the emergence of a new, energetic audience. The resulting heterogeneity of the discourse was a reminder of the fact that science popularisers were beginning to work on multiple priorities. The vision of new, prosperous independent nation had altogether changed the meaning of science popularisation. We conclude our discussion on Bengal with a comparative analysis of the strategies and goals adopted by M.N. Saha and S.N. Bose. Tracing the cultural roots of these two working scientists, who did as much science within the four walls of their respective laboratory as outside, Enakshi Chatterjee further contextualises their position *vis-a-vis* vernacularisation of scientific knowledge.

The popularisation activities of the early pioneers from Bengal had inspired similar sentiments elsewhere. The most important example is that of Ruchi Ram Sahni from Punjab. Ruchi Ram started off from Calcutta where he had the opportunity of attending popular science lectures arranged by IACS. Greatly impressed by the activities of IACS he followed this up by creating the Punjab Science Institute on his return to Lahore in 1886. Kamlesh Mohan and H. S. Virk in two separate articles analyse Ruchi Ram's commitment to popularise science among the rural society of Punjab which had been seized by superstitious beliefs. The very fact that Ruchi Ram had been reared in such popular, misplaced beliefs, had a revolutionary effect on him. Pledging to end this reign of darkness Ruchi Ram travelled most parts of the Punjab, giving lectures on the practical applications of science and demystifying the secrets of experimental science. Treading in the path of vernacularisers, Ruchi Ram adopted Punjabi, the

language of rural folks, to convey the meaning of scientific knowledge to the rural zamindars as well as town-based traders.

The other two essays (about Delhi and Assam) included in the last section of the book are only a reminder of the fact that regional variations notwithstanding science popularisation was emerging as a national project. A common factor linking these activities across the country was, as S. Irfan Habib suggests somewhere in his essay on Munshi Zakaullah, their increasing faith in the domestication of not only the literature but also of thoughts. Representing the ethos of Delhi renaissance, Munshi Zakaullah strived to reemphasise the role of science and scientific values for cultural and material advancement of his countrymen. Undazzeled by the flashing light of modern science Zakaullah emphasised that the splendours of nature and the miracles of human ingenuity could only be witnessed when the eyes are accustomed to this light. He then launched a mass programme for getting the eyes accustomed by publishing as many as 146 books on scientific and other topical issues, all in Urdu. Endorsing the belief that science was the highest form of rational amusement, at least for the general public, Zakaullah presented his subject in very simple language using vernacular terminology of the English equivalents.

The vernacularisation of scientific knowledge in British India was a well thought strategy to ward off the hegemonic designs of alien cultures. Given the plurality of Indian society it would be wrong to project the European culture as the only enemy throughout India. Marginal cultures lying on the remote periphery were required to guard against the increasing influence of the dominant Indian culture. This very topical issue has been the subject of Bandita Phukan's paper on Assam. Tracing the early penetration of both the English and the Bengali entrepreneurs in Assam and the threat this penetration caused to local values, customs and knowledge, Phukan narrates the defence mechanism adopted by the people of Assam. Promotion of their own language, the Assamese, was a key factor of the whole strategy. Further encouraged by the American Missionaries they launched *Orunodoi,* the first Assamese magazine that pledged to popularise the tenets of science and general intelligence. Another Assamese magazine, *Jonaki,* was started in the late 19th century by the students from Assam studying in Calcutta. The magazine turned out to be a popular science magazine by simplifying some of the mysteries of the physical world and by also exposing its readers to the technological innovations taking place allover the world. Another major investment of *Jonaki* was to promote original writings in the Assamese. Here we

find writers like Rajanikanta Bordoloi (a student of the Calcutta Medical School) writing some of the best popular stories on scientific matters. And as Bandita concludes the popularisers from Assam might not be as effective as their counterparts in Calcutta, the people on the extreme periphery were no less aware of the importance of science and scientific methods.

Popularisation being an 'expression of interests',[17] interests of not only the popularisers but also of their audience, our book reveals the identity of science audience as well and further contextualises the interests of the various human categories involved in the discourse. In a cultural hierarchy promoted by colonial penetration it is not surprising that the audience of a colonial (European) scientist were drawn from the ranks of European community: members of the Court of Directors, the Board of Control and a whole class of speculators scattered on the periphery. It was only a selected band of 'natives'(mostly princes and neoentrepreneurs like D.N. Tagore) who had direct access to the western knowledge producers. As for the local popularisers their audience had changed from place to place over a period of time. While early philanthropists concentrated on the city-based educated class later professionals had begun making inroads into an otherwise closed rural society. While Zakaullah had a comparatively elite audience in Delhi, Sahni on the other, was received by all sections of the society: the traditional feudal lords, the emerging town elite, the traders and professionals. In Bengal, at the same time, if Trivedi and S.N. Bose had wished to popularise science at all levels, the increasing tendency to educate the layman did not meet the approval of a developmentalist like Saha. Sharing a common vision with George Sarton (quoted at the beginning of the introduction) Saha had no intention to educate the layman. His preference to English for writing popular science essays would suggest that he was looking for a more responsive audience, the policy-makers.

This difference of perception on the part of colonial and local Indian science popularisers was also reflected in the interests they cherished in the whole discourse. So far as the colonial scientist was concerned the promotion of science among the Court of Directors and the Board of the Control, the two executive bodies represented by what Karl Marx would despairingly call them' tenthrate statesmen',[18] and overzealous bureaucrats from the Revenue and Finance departments, was rooted in his need for material support from the state. Matêrial interest apart the colonial scientist was also encouraged by a desire to enhance his social standing *vis-a- vis* other specialist

groups operating on the periphery. Wallich's decision to distribute his botanical collections among the leading botanists and botanical institutions across the world was in fact part of this strategy to earn self-respect and greater support for science.[19]

His Indian counterparts, on the other hand, were inspired by a desire to improve the intellectual and material conditions of their countrymen. While some of them (R.L. Mitra, M.L. Sircar, M.N. Saha and Ruchi Ram Sahni) were guided more by a developmental ethic, for others (like Ramendrasundar Trivedi, Bankimchandra, P.C. Ray and S.N. Bose) it was a passionate expression of the patriotic sentiments. Earlier in 1847 Ishwar Chandra Gupta, while regretting the closing of the Calcutta Mechanic Institute, had announced that industry and technical skills were essential for a nation's progress[20]. P.C. Ray's science was also a national project. His project to trace the early roots of science in Indian tradition was inspired by the spirit of national awakening of his time.

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Part One
Boundaries of an Emerging Discipline

Science and its Public in British India
Problematic of Diffusion and Social Appropriation

Satpal Sangwan

Conventional narrative of the empire-science problematic have not yet addressed some of the key issues residing outside the political and cultural (hegemonising) interests associated with scientific projects on the colonial peripheries. The social mobilisation of science beyond the European metropolis is conspicious by its absence in the dominant agenda. Founded outside the framework of internal history of science the narrative of 'colonial' science is at equi-distance from the whole PUS agenda. Although the inadequacies of colonial scientific discourse would have disallowed local participants at equal terms the discourse was nonetheless, for public scrutiny and further not so inaccessible appropriation. In order to appreciate the social impact of scientific not so inaccessible knowledge it is necessary to admit that a wider society existed beyond the known constituency of science, a world of various audiences of science. In a colonized society the audience were drawn from various layers of a cultural hierarchy: the non-scientist European professionals employed in the military and medical services of the colonial state, transplanted European speculators looking for new fortunes in the East, the native princes, the emerging class of entrepreneurs, and a thick layer of new literati sharing a common vision with their European collaborators. The appreciation, approbation and appropriation of the scientific knowledge by all these human categories was as important as its generation.

Recounting the common strategies employed both by the performers of science and their audience to legitimise their respective claims to knowledge sharing this paper envisages a broadened agenda for the social history of scientific discourse in nineteenth century India. Limiting our inquiry to the 'wasteland' area lying between the 'diffusionist' and the 'imperialist' models we analyse, in the first part, the appropriation of new knowledge by colonial scientists and their collaborators: the commentators, communicators, popularisers, users, and audiences. Second part contextualises the acceptance and assimilation of alien knowledge by the indigenous communities. The main objective of our endeavour is not only to trace the roots of the PUS agenda but also to unveil the public face of the exploratory

science. Whether we are able to bring science 'down to earth', as it has been articulated by J.A. Secord, is a matter of conjecture.[1]

Constructing the Cultural Context: secret Vs public knowledge

Science has been a 'contested territory' throughout the pre-industrial period. The contest was rooted in the dichotomy between esoteric and exoteric knowledge. For many, including some of the scientific elite, it was built around the issue of whether science should be popular, in the sense of being open to a wide range of participants who could contribute to and benefit from the production of knowledge. Any analysis of the process through which scientific knowledge has come to stay with lay constituencies would require it to be contrasted with the classical norms of 'secrecy' maintained both by the artisanal class and the natural philosophers. In one of the most revealing study of scientific 'secrets' William Eamon has demonstrated their relevance in a closed society and the process through which the secrecy norms were discarded by the emerging 'moderns'. Fifteenth century engineer Mariano Taccola (1382-1453) was warned by Brunelleschi to conceal his invention from public: 'Do not share your inventions with many, share them only with few who understand and love the sciences'.[2] Technical recipes were normally the property of craftsmen working under the threat of guild mafia, who would not allow them to share the trade secrets with others, lest they loose their monopoly. Giovanni da Fontana (c.1395-c.1455) composed several highly original treatises on technology, all written in cipher to prevent them from being read.[3] The coded language of the ancient Indian civilisation, it now seems, could also be a ploy to guard against the competing tribes. During the early days of the Royal Society some members were reluctant to reveal secrets. Edmund Wylde, elected in 1661, refused to demonstrate the technique, he had claimed, of softening steel without fire because he esteemed it a secret.[4] Personal preference apart the question of national security also called for the concealment of scientific knowledge. William Pelty's manuscript on shipbuilding was concealed by William Brouncker, the president of the Society, on the ground that it was 'too great an arcanum of state to be commonly pursued'.[5]

In Europe, in the meantime, the emergence of new technology, new scientific institutions for the promotion of scientific activity and institutional mechanisms to protect the interests of discoverers during the 16th-17th centuries, gave vent to what was later called 'public knowledge'.[6] At societal level the recognition of the social, commercial and political value of scientific knowledge-(utilitarian ethos), opened

science for public debate.[7] Emerging out of this debate was the progressive spirit of science making it more attractive to the average man, coupled with its capacity to meet immediate needs, whether of a utilitarian or humanitarian nature.[8] In his earliest published works Robert Boyle chastised the 'secretists' charging that their only motive for concealment was vanity and avarice.[9]

During the Newtonian era basic attitude to science *vis-a-vis* national interests had turned full circle in England. Unable to challenge the 'ancients—primarily the continental rivals like France, Italy, and Spain—on literary plank, Englishman found his refuse in science.[10] Further onward during the Napoleonic wars scientific glory became, as Sir Humphry Davy explained it, 'an indicator of the innate strength of a nation'.[11] Davy placed science above colonial possessions in the hierarchy of factors contributing to the wealth of a nation, arguing that foreign conquests in themselves did not make a nation great; the conquest of nature in one's own country was more important. It was not colonialism, the great science populariser of the day had announced, but cultivation of native riches (science) which constitute the source of Britain's pre-eminency.[12] The rising importance of science coincided with the gradual democratisation of English political life and the increasing demand for public participation in the pursuit of knowledge.

The rising faith in the prestige of scientific projects soon translated into a genuine demand for its diffusion among a lay constituency, not only to bring some balance to public thoughts on the value of science,[13] but also to earn social legitimacy for a scientific experiment—'the more accessible, the more the credibility'.[14] The diffusion of knowledge, as Henry Brougham termed it, became a distinct achievement of the 'men of letters' of the Tudor period.[15] Founding of the Society of the Arts in 1755 was a strong indicator of this new mandate. In 1810 the Royal Institution became a public body for, among other things, the 'diffusion and extension of useful knowledge in general'.[16] Science popularisation gained momentum during 1824-1851 as middle class philanthropists tried hard to disseminate 'useful knowledge'. The period saw the rise and fall of the Mechanics institute and the increasing opportunities of access to scientific knowledge through the publication of tracts, text-books, journals, growth of libraries and museums.[17]

In India pre-colonial scientific knowledge was as controlled as in pre-Newtonian England. The literature and sciences of the Hindus never went beyond the 'limits of the learned few'. In the absence of

social mobilisation for openness in science and technical arts, the possessor would not let it go beyond his own blood-relations. This was desired to maintain both social identity and trade monopoly. The brahminical control on knowledge and guild control on technical expertise kept a large mass of people at bay from the sacred knowledge. The educational arrangement also helped to maintain this segregation among different streams of knowledge. The arrangement lingered on until the end of the 18th century. William Jones found local brahmins extremely reluctant to share the 'secrets' of the sacred language (Sanskrit) with a foreigner and an intruder. Jones finally ended up with a non-Brahmin vaidya, who agreed to teach the future Orientalist, albeit on his own terms.[18] Writing some quarter of a century later A.F. Tytler noted that knowledge (of 'philosophy, history, astronomy, and other useful and elegant sciences'), controlled by Brahmins in a traditional social structure, all but failed to make a 'beneficial influence on the body of the people' even when education was opened for all by the British.[19] It is against this background that we now trace the opening of the field of science for people residing outside its immediate boundaries.

Broadening the base: science for non-scientist

Conceived as an 'appropriate simplification' of 'high' scientific discourse for the benefit of and intelligible to the non–scientist',[20] popularisation of science rests on communication context– the means employed by science popularisers for carrying scientific knowledge to a wider audience. Mainly there are three co-extensive social phenomena— the popularising activities of specialist organisation which organise frequent soirees and public exhibitions, the wide diffusion of popular scientific journals, and the burgeoning manufacture of cheap literature.[21] In addition to these pro-active means of communication a lot more depends on the quality of knowledge produced. Paradoxically speaking the scientific projects initiated by the transplanted Europeans upon their first arrival on the colonial periphery were devoid of a rigorous theory. The first phase of the spread of western science (exploratory science), has been termed as of no serious consequence so far as the birth of a scientific culture outside Europe is concerned.

Looked from the vantage of public image of science this was, however, a period of great importance. In fact the intellectual 'limitations' of a scientific discourse during the first phase were sought to be compensated by a plan to broaden the base of the 'republic of science' by involving non-scientists. Its theoretical underpinnings were

rooted in the Banksian agenda of 'soft' science. In England Joseph Banks, who ran the Royal Society like a monarch for more than four decades, preferred 'the disciples of Linnaeus over those of Newton' because the former had larger audiences. Besides, this form of natural knowledge had specific utilitarian agenda especially for the landed classes and their sycophants. Therefore, during Banks' tenure (1778-1820) as President of the Royal Society 'polite knowledge and practical improvement went hand in hand' as president of the royal society in England.[22]

Public acceptance of natural knowledge also helped Banks to meet the challenge from his opponents. That a great mass of general public in England had come around to appreciate the tenets of exploratory science is further testified by the fact that natural history became part of working-class' 'rational recreation' during the early nineteenth century.[23] In fact part of the growing tension between the 'Banksian Learned Empire' and the 'Mathematical Practitioners' was rooted in the widening gap between public and specialised science. It was primarily on account of the user-friendly scientific knowledge like the one defined and desired by Carl Linnaeous, von Humboldt and Roderick Murchinson that the early popularisers decided to reach out to lay audience. Even the later specialists like H. Davy and T.H. Huxley promoted a 'user-friendly' image of science assuring their audience that science was, after all, 'nothing more than the refinement of common sense', a common sense which 'put the man of science and man of sense more or less on a level. One of Huxley's strategies during his public lectures was 'to make his audiences realise that they did science all the time'.[24] In India the popularity of botanical lectures delivered by Nathaniel Wallich at the Calcutta botanical garden also sustained on the mass appeal of the Linnaean language.

The agenda of exploratory science conceived and propagated by imperial scientists like Banks and Murchinson was well served by the opportunities available to the gentlemen amateurs on the periphery. Based upon the obvious, easily grasped physical characteristics, natural history soon became popular among those who wished to record their observations in the simplified 'scientific' nomenclature. Separated from the comforts of metropolitan social circle the transplanted Europeans sought to create one on the periphery using the Linnaean nomenclature as an added attraction for the participants. The growing popularity of Linnaean literature among the transplanted Europeans is an important indicator of this change.[25] Letters received in the office of the Linnaean Society in London from India reveal the

growing demands for the Linnaean literature from not only serious men working in the woods but also from 'drawing room botanists' looking for a delightful print material to be enjoyed during their 'hours of leisure'.[26] Although serious botanical collectors and writers had begun returning to a more sophisticated natural around 1830s,[27] the popularity of Linnaean literature lingered on, thanks mainly to these fashionable readers.

In addition to the 'popular' image of exploratory science there were other supporting factors for the emergence of science as a public domain. Institutional support in science popularisation came in the form of scientific societies promoting public demonstration of new discoveries, popular lectures, publication of scientific texts and scientific journals. A major attraction of the scientific societies was their professed mandate of promoting 'useful' knowledge in a simple vocabulary of science. The term 'useful' was a piece of philosophic rhetoric. It reflected the progressive idealism of the age: 'the more people acquainted with useful knowledge, the faster the progress of society'.[28] Though many of the 19th century scientific societies, founded as they were with exaggerated promises, did not stay for a long time, yet even in their sparkling appearance these societies were able to articulate a notion of science that could be assimilated by non-scientists.

Advancement in science, as the 19th century popularisers including the societies, believed, could be best achieved through the accumulation of new data. Therefore, major investment of these societies was toward promoting mechanisms of knowledge sharing and knowledge generation. In this context there is a striking similarity in the agenda of such promotional societies operating from the centre and periphery. For example in England the Society for the Diffusion of Useful Knowledge, which was founded by Henry Brougham in 1826, carried such popular mission. 'Great discoveries', Brougham believed, 'were seldom made by ignorant persons; but a little knowledge, far from being dangerous, greatly increased the chances of discovery'.[29] It is on this programmatic agenda rather than the number of years a particular society survived or\and the number of members it was able to enrol, that there is a strong case for a further analysis of their contribution.

The Asiatic Society of Bengal (f.1784) found it expedient to confine itself to the harmless antiquarian researches. Modelled on the Royal Society, the ASB was not meant to be an exclusive club of men of

science. Among the 12 members who contributed 3 or more papers to the first 18 vols. of *Asiatic Researches*, all but three wrote on literary, linguistic and historical topics'.[30] Later, as the colonial state engaged in the debate on the future course of education for the people of India, there was a further demand for literary societies. In western India, the Bombay Literary Society (BLS) was started in November 1804 with the active support of Sir James Mackintosh, Chief Judge in Bombay.[31] Sharing the agenda of ASB, the BLS encouraged scientific discussion, opened a library, a museum and an Astronomical Observatory in 1805.[32] A similar society, The Madras Literary Society, was then founded in south India in 1818 through the exertions of Benjamin Babington, who had earlier noticed the positive results of the BLS while posted there for some time.[33] By the middle of the century the Asiatic Society of Bengal had run into some 'academic' problems, largely as a follow-up of the Declinists' movement in England. Some of the members attacked its amateurish character. It was under these circumstances that a break-away group founded the Bethune Society in December 1851 to promote a taste for literary and scientific pursuits and to encourage a free intellectual discourse among the emerging *bhadralok* of Calcutta. The Bethune Society arranged monthly lectures at the Theatre of the Medical College. Popular lectures were delivered on literary, scientific and social subjects.[34]

In addition to such societies with general specifications a few specialised scientific societies were also launched to meet the growing sectoral needs. In 1817 William Carey founded the Agricultural and Horticultural Society of Calcutta. Beside holding public demonstrations of improved seeds and agricultural implements the Agr. Hort. Society also laid out an agricultural park–Poosa Garden–at a monthly expenditure of Rs. 100.[35] Initially the proceedings of the Society were published in English, thus denying local zamindars any access to its recommendations. Some time later the society began translating all its papers into 'native languages'. Still the number of the natives joining the society was found to be less than what W. Carey had expected.[36] To encourage native talent in agricultural pursuits the society offered a grant for the best essays on a variety of agricultural subjects, such as Indian soils, manure, the acclimating of foreign plants, on the cultivation of indigo, sugar-cane, coffee etc.[37] Carey circulated queries among aspirant contributors asking for suggestions as to the promotion of Indian agriculture. It was further modified and translated into Hindi, Hindustani and Bengali languages some two

decades later. Beside popularising science through textual literature the Agr. Hort. Society also promoted local area networking with local or branch societies which came up at Lucknow, Meerut, Madras, Bangalore and Lahore, thus assuring co-operation of individuals placed in 'every variety of soil'.[38]

A large body of the Europeans employed in the service of the East India Company had been lured to the east for two reasons, knowing the tropics, and earning great fortunes. Compared to the 'fortune-seekers' the 'knowledge-seekers' were drawn from the pool of young medical students passing out from the Scottish and other North European universities. What they dreaded most in the east, beside the malarious environment, was the total academic isolation. For months and perhaps years, they would 'hear and see nothing of the stir of science, and catch but indistinct and partial glimpses of the advancement of knowledge[39]'. To obviate such disadvantages David Hare founded the Medical and Physical Society of Calcutta in March 1823. Its object being the advancement of 'Professional (Medical) knowledge' the Society insisted communication on variety of subjects ranging from medical topography to tropical diseases and their local therapies. MPS promoted co-ordination among the medical men, scattered far apart from each other, over a vast extent of the country.[40] The Phrenological Society of Calcutta, founded in 1825, sought to investigate and promote phrenology 'by means of meetings', phrenological discussions, communications, and by the 'collection of phrenological works, skulls, casts, and every kind of phrenological document and illustration.[41]

The institutional form of scientific and literary activities also inspired technical person to look for an institutional umbrella. In 1855 Col. Goodwin circulated a pamphlet carrying his plans for the creation of a Society of Arts and Sciences in Bengal. The society was desired to give an impulse and systematic direction to 'Artistic and Scientific Practice and Enquiry'. Strategies planned by Goodwin included popular lectures, exhibition of works of arts and science and publication of transactions 'for the general dissemination of Artistic and scientific knowledge'.[42] Goodwin hoped that the Society would 'diffuse a taste for the arts which adorn and elevate society'.[43]

Generally speaking scientific societies that came into existence through the active involvement of colonial state catered to the needs of transplanted Europeans, affecting local networking and publishing their personal notes and papers. Popularising activities of such state-

sponsored scientific societies could not penetrate the thick cover of gentlemanly amateurism. But even if conceived as exclusive clubs for the uprooted Europeans these societies were able to evoke some interest among the natives who also founded their own scientific societies. The local scientific societies adopted a more pragmatic line of action, publishing school text-books, translating European works of science into regional languages. In this case one cannot fail to appreciate the works accomplished under the direction of the Aligarh Scientific Society, and the Bihar Scientific Society.[44] Similar societies also sprang up at other places like Lahore, thus forming a network for sharing text-books and other sources of information. Aligarh Society exchanged books with the 'Society for the Diffusion of Useful Knowledge', founded by Pandit Harsukh Rai at Lahore, and the 'Mohemmadan Literary Society' of Maulvi Abdul Latif Khan at Calcutta.[45]

Regional societies, however, failed to produce a long-term agenda. Their emergence on Indian scene is seen much like the pre-monsoon clouds with all thunders but no rain. But they certainly announced the impending monsoon clouds. That refreshing moment came when M.L. Sircar came forward to establish the Indian Association for the Cultivation of Science in Calcutta in 1876. Sircar agenda included an exhaustive plan of science popularisation. He promised that IACS will 'initiate two series of lectures on each subject, one for the general public, and the other for the instruction of few who would like to form themselves into a class to learn the subject'. Beginning with a modest audience Sircar promised to reach to 'thousands and hundreds of thousands'.[46] The nineteenth century thus ended with a positive thinking on the whole agenda of science popularisation through institutional platforms. The twentieth century began with renewed promises offered by the Dawn Society (f. 1902). Founded in the wake of *Swadeshi* movement the Dawn Society worked in the area of technical education, finally leading to the opening of the Bengal Technical Institute.[47]

Communication context: periodicals and newspapers

One of the most important channel through which science reached to a larger audience was scientific periodicals. A survey of contemporary science journals and newspapers carrying features and advertisements about scientific projects will reveal the pattern of science communication. The professed object of early 19th century science periodicals, both at the centre and on the periphery, was to open out science by 'diffusing Philosophical knowledge among every class of

society'.[48] The first scientific journal on the Indian periphery was launched by the Asiatic Society of Bengal. Conceived by William Jones in 1784 the *Asiatic Researches* sustained on and promoted amateurs in science. Its first eighteen volumes are filled with statistical reports on the natural habitats (astronomical, geographical, geological, meteorological, botanical, zoological, ethnographical, apparently for the benefit of those who wanted to know the tropics in a more accurate manner.[49]

Around 1820s there was a spurt for more specific science journals in Calcutta catering to the needs of emerging specialist scientific groups. *Transactions of the Agricultural Society of India,* launched by the Agricultural - Horticultural Society of Calcutta in 1823 turned out to be the first 'scientific' journal on the subcontinent. For serious workers in the field of natural history John McClelland launched the *Calcutta Journal of Natural History.* Medical interests were first represented by *Transactions of the Medical and Physical Society of Calcutta* (f. 1825). Later in 1837 it was superseded by the Quarterly *Journal of the Medical and Physical Society of Calcutta.* In 1834 Frederick Corbyn became editor of the *Indian Journal of Medical and Physical Science.* Two years later he launched an independent magazine, *India Review and Journal of Foreign Science and the Arts* with a view to defuse the 'light which discoveries and improvements in Europe were hourly shedding through the medium of science and the arts'.[50]

Beside the 'specialised' journals there were a few others which were more liberal in the selection of scientific topics. In 1829 James Herbert started *Gleanings in Sciences* for 'serious men of science'. Two years later James Princep took over its editorship. As Secretary of ASB Princep arranged its adoption by ASB in 1832 with a new name, *Journal of the Asiatic Society of Bengal.* Pressure from more serious professionals led to its division in 1837 into two parts: scientific section, and the historical and literary section. The overall growth of periodicals was slow yet steady. In 1857 there were about 22 periodicals in Calcutta alone. But only a few could be called science periodicals.[51] In the emerging competitive struggle between the neo-specialised and traditional scientific periodicals for space in the public press the latter were gradually weeded out. First to go at this stage was the *Asiatic Researches* which was finally withdrawn in 1839. Later in 1865 the ASB began publishing its *Proceedings.*

Examination of the background and career patterns of editors of

19th century science journals will reveal, as Sheets Pyenson has shown in the case of London and Paris periodicals, 'why they often were not mere popularisers of high scientific activity, but rather the architects of an alternative low scientific culture'.[52] Let us, for example, consider the case of Frederick Corbyn, a leading science editor of early nineteenth century India. Corbyn was born in Manchester. After completing his medical education he joined the colonial army. But his future awaited him elsewhere. An 'ardent lover of science, and a zealous promoter of knowledge', Corbyn devoted 'the leisure moments of his life to the exposition of the one and the diffusion of the other'.[53] As an editor Corbyn always insisted on the freedom of the press. 'But for the freedom of the press', he would remind his contributors and subscribers, 'science would have been smothered in its infancy by those who are the persecutors and oppressors of the advocates of free discussion'.[54] For others like James Herbert 'communication' was one of the duties impressed upon by the growing spirit of the age.

Popular science periodicals in India followed the metropolitan tendency of promoting 'amateurism in science'. In England the architect science popularisers of the time sought to translate and simplify the discourse of the world of the savant so that it could be comprehended by non-scientist readers. The whole project was aimed at broadening the base of the Republic of Science.[55] In India also the science journals were less concerned about publishing research papers for professional reader. Wider dissemination of knowledge was their main concern. Corbyn's *India Review* for instance, transcended the disciplinary boundaries of a science journal as it adopted a combination of science and 'other interesting subjects' in order to suit the 'taste and promote the benefit of all classes'.[56] Utility was the guiding force: 'that which is known to few, cannot be of extensive utility'.[57] First batch of readers primarily consisted of transplanted Europeans who had to be informed of the latest developments back home. While launching *Gleanings* James Herbert announced that it would publish the reports of the 'progress of European science', extracting information from European journals. He defined the object of science periodicals as 'to collect and retain the scattered rays (of European science) till they can be combined into one strong focus of light'.[58] Corbyn wished his *India Review* to be 'exclusively devoted to the review of works on science, embracing foreign science and the arts'.

A major departure came when the *Calcutta Journal of Natural History* was brought out to meet the requirements of a growing community of more committed professionals. It addressed working

naturalists, not the laymen. 'The labours of naturalists', as J. McClelland, the founder editor, pointed out, were 'sufficiently important to entitle them to a separate and independent organisation', and particularly a science journal.[59] With the sixth vol. of *CJNH* Robert Wight, a well-known colonial botanist, began his 'Notes on Indian Botany'. In precise terms it was an endeavour to communicate observations on matters of 'sufficient scientific interests'. viz., discussions on natural affinities, on the composition and characters of natural orders, revisions of the old, or descriptions of new genera, descriptions of new or imperfectly known species etc'.[60] Scientific journalism was turning into a professional exercise. The commitment of editors was in no way *adhoc.* While replacing William Griffith as editor of the botanical section of *CJNH* Wight had assured his friends of his determination to place Indian botany 'on a par with English'.[61]

In addition to their efforts to disseminate scientific knowledge, the popular science journals of the 19th century also drew public attention to the changing priorities of not only theoretical knowledge but also of the institutional forces of science. Two episodes are noteworthy. First, when the Declinists' movement rocked institutional science in England during the 1830s it had some bearing on India. In the IInd volume of *Gleanings*, James Herbert reviewed Babbage's *Reflections on the Decline of Science in England* and suggested that ASB suffered many of the sins Babbage had laid at the door of the Royal Society.[62] The debate also inspired *The Calcutta Journal of Natural History* to demand the formation of Indian Association for the Advancement of Natural Science (1841) on the model of The British Association for the Advancement of Science (BAAS). The journal found that 'existing societies' were 'not adopted to promote that pursuit (natural history)', both due to 'paucity of means, as from their subjects being chiefly directed to investigations in literature, agricultural and medicine'.[63] Frederick Corbyn also hailed the BAAS and wished the dawn of a 'similar era in British India'.[64] Second episode relates to the recommendations of the Lindley Commission on the functional role of Royal Botanic Gardens at Kew. The commission had made a scathing attack on the 'lack of purpose' in the direction of Kew gardens, especially in relation to the emerging network of botanical gardens on colonial peripheries. The report, as it suggested an alternative plan for the functional role of botanical gardens, was reproduced by the *Calcutta Journal of Natural History* for debate and discussion on the future direction of Calcutta Botanic Garden.[65]

When discussing the role of scientific periodicals in science

popularisation one cannot fail to appreciate the contribution made by vernacular or regional periodicals. Theirs was, in fact, more effective contribution so far as the local audience was concerned. The first Bengali science periodical called *Bignan Sar Sangraha,* was started by the young Derozians to spread scientific knowledge. The other leading Bengali science periodicals included *Vigyan Kaumudi* (1860), *Vigyan Rahasya* (1871), *Vigyan Vikas* (1873), *Vigyan Darpan* (1876), *Sachitra Vigyan Darpanh* (1882), *Chikitsa Darshan* (1887).[66] The *Sambad-Prabhakara* (1830-50), *the Tattvabodhini and Vividhartha Samgraha* (1851) had also envisaged a common objective of 'Indianizing western science'.[67] There were similar science magazines in other regional languages as well. Master Ramchandra, a science populariser from Delhi, brought out two science magazines in Urdu, *Fawaid-ul-Nazrin,* and *Mohabb-i-Hind,* through which he sought to popularise science.[68] In Bombay B.G. Shastri Jambhekar, started *Bombay Darpan* in 1831 for popularising science. In the south there were a few science magazines in Tamil, Telugu, Kanada and Malyalam. Further research is needed to get a clear picture of the relevance of vernacular science periodicals.

Contemporary newspapers, both mainstream and vernacular, though founded under the impelling political compulsions 'did a bit of science popularisation' as part of their strategy to reach to a responsive audience. There were two kinds of reporting on scientific matters: introducing general readers to the advancing frontiers of scientific knowledge and as critic of a particular scientific project. In the first case again there were two most visible means, through textual information and through advertisements. There is a great scope for articulating this participatory practice on the part of contemporary newspapers in matters of knowledge sharing and knowledge generation. Some of this is reproduced here to reaffirm the point.

Newspaper reporting on science began with issues relating to agriculture largely because a majority of their readership belonged to landed aristocracy. In 1839 Henry Piddington had submitted a plan for the institution of an Agricultural Professorship in the Hindu College, saying that 'we possess an order of sciences which might exert a great and beneficial influence upon their, land lords worldly and our financial prosperity'. *The Friend of India,* which reproduced his pamphlet, noted that 'the students of our colleges will, in many instances, be our future zamindars. But none of them will be farmers; and without a corresponding elevation of the farmers, the agricultural instruction and zeal of the landlords will be of small avail, nay, often

worse than profitless'. The paper further suggested that 'vernacular education must be brought within the reach of all our peasantry, and agricultural information form a part of it, before much good is to be expected from educational means'.[69]

The other end of debate on the issue of agricultural improvement was held by the *Lahore Chronicle* which found science as a useful component for the development of agriculture. For practical sciences like agriculture, the paper noted, a knowledge of the climate and qualities of soil was 'essentially necessary'. Ridiculing the scientific amateur farmers of England who burnt 'their fingers' while resorting to scientific farming, it further reasoned that 'science misapplied' was 'often worse than no science at all'.[70]

In addition to such 'academic' debate on the relevance of science for developing the agricultural resources of India there were some interesting reporting on new discoveries in the agricultural sector. In 1857 the *Englishman* reported the discovery of 'a new kind of manure', 'a chemical composition', the nature of which was still kept secret by the French inventor.[71] Before that the same paper had brought to the notice of its readers a whole process of clarifying sugar by soap. It was invented by one Mr. Garcia, a sugar-refiner of Louisiania, and introduced to L' Academics des Sciences at Paris by M. Basset.[72] A major attraction of the period was the new agricultural machinery. Here also the newspapers offered insights into the emerging sophistication in agricultural implements. The steam plough invented by John Fowler of Cornhill, London, in 1857, found full coverage in the Indian newspapers.[73]

The native press was equally enthusiastic about other technological marvels. The introduction of electric telegraph, for instance, was reported with a bang. This novelty, *The Friend of India* hoped, would 'introduce us into a new state of existence'. Reminding of the times when a voyage to or from England occupied four months, and when a reply to any communication was occasionally received in eight months, the magazine underscored the 'nature and extent of the change which has been produced in the feelings of the mind by the constant receipt of intelligence, through the steamer in thirty-six days, and of reply to a letter in less than three months'. The advent of the telegraph was a real revolution which enabled 'communication with the most distant places in a few hours'. The paper further alluded to its advantages for local mercantile community, through quick 'intelligence of the state of markets at the different marts and of all

those circumstances which regulate the rise and fall of prices'.[74] Similar reports poured in from other newspapers with some like *the Englishman* speaking of 'the advantages of one of the most important discoveries of this age'. There was none more useful nor more wonderful than this method of conquering the obstacles of time and space and uniting the most distant parts of the earth by the instantaneous communication of thought'. The paper further referred to the self-contrived telegraphic instrument of O'Shaughnessy and narrated its successful trial on the London-Dover Line by Mr. Walker, 'the greatest authority on electric telegraph'.[75] A few others called for the public appreciation of Sir. W. B. O'Shaughnessy, the architect of electric-telegraph in India. Public appreciation of men of science was most desirable since, as the *Bengal Harkaru* pointed out, 'the encouragement that science received from the India House was 'not very great'.[76]

In addition to introducing specific technological projects to Indian readers the native press also did strive to reclaim the Indian glory in science and technology. Contesting the myth of European superiority in science one reader reminded the editor of the *Hindu Patriot* that 'the civilization of the ancient Hindus was by no means inferior, if not superior, to that of the modern Europeans'. This gentleman agreed that 'the sight of huge steamers, railroads and electric telegraphs may produce a higher and nobler idea of the civilization of the West, but it must be confessed at the same time that there is nothing, not the slightest ground to suppose that the sciences which have given birth to these all absorbing wonders of the age, were not in existence or known to India.' He further went on to refer (not by name) to a 'few relics of scientific works' in Sanskrit.[77] Ambitious it may sound but the message was clear: to re-establish a link between popular culture and the tradition of science.

Historians of science are coming around to look beyond the conventional disciplinary boundaries. In the process they have identified not only new problems but have also located some of the most interesting sources of information. In the sociology of science, for example, Janet Browne has added yet another kind of 'popular' science magazines addressing a very active, responsive constituency of science audience i.e., the university under-graduate magazines. 'The interrelations between teachers and students', as she explains, 'go right to the heart of the actual processes involved in adopting and disseminating particular scientific viewpoints through a larger social realm'.[78] When we look for a similar interactive process in India we

find science students demonstrating a tolerable amount of interest in the culture of science. Students of the Elphinstone College, Bombay, for example, founded a students Literary and Scientific Society. Around five to six hundred students heard lectures on chemistry by Ardaseer Framjee, and later attended a course on mechanics, hydrostatics, pneumatics, optics, heat, electricity and magnetism by Dada Bhai Naoroji.[79] A further enquiry into the cultural activities of science students across the country will indeed reveal interesting facets of popular perception of science and scientists.

Science for the beginners: text-books

All lofty claims for the existence of a wider network of elementary education in pre-colonial India notwithstanding one most crucial feature of the colonial model of education was its faith in textual rather than oral information. The professed aim of British education policy remained dissemination of western ideas, both cultural and scientific, among the natives of India. This, they realised, could be more effectively addressed through textual means. This single factor was much more effective in a wider dissemination of knowledge than a few hundred village *pathsalas* put together. The history of scientific text-books, therefore, is as important a sub-discipline of 'colonial' science as its political agenda.

Scientific text-books reached to the class room through a wider network of participatory management involving authors, translators, promoters like school–book and other scientific societies, and the government department of education. Initially most of the science texts and manuals recommended for Indian schools were written by western authors for European schools. Later School Book Societies sprang up in Calcutta, Madras and Bombay and in other mofussils. Their agenda was to ensure a supply of manuals for school education. The Calcutta School Book Society was started in 1817, followed by one in Madras in 1820, and another in Bombay in 1822. Most of the manuals were translated from English. During 1822-23, for instance, the Bombay Society published a book on *Gunit* or *System of Arithmetic of the European Plan*, in Gujrati. Besides, Colonel Palsey's *Practical Geometry*, Hutton's *Mensuration of Planes and Solids*, and a treatise on Plane Trigonometry were translated into Marathi and Gujrati.[80]

Translation projects of similar nature were on in the mofussil areas as well. For example, the Delhi College created an Education Committee in 1835 for the translation of text-books in Urdu. The whole project was looked after by a sub-committee, the 'Society for

the Promotion of Knowledge in India through the Medium of Vernaculars', popularly known as the Delhi College Vernacular Translation Society (VTS). The translation job was supervised by a French educationist, F. Boutros, and his German partner Sprenget. VTS translated about 125 books in a span of 20 years.[81] Translation was one of the major activities adopted by regional scientific societies. In 1867 the Aligarh Society issued a memorial for the diffusion of European sciences through vernacular languages. The Aligarh Society translated about 40 European books, including R.S. Burns' *Modern Farming*, W.S. Harris' book on Electricity, C. Tomlinson's work on mechanics and many other books written by Todd Hunter, Bernard Smith, Galbraith and Haughton on meteorology, chemistry, algebra, geometry, hydrology etc.[82] The Bihar Scientific Society (founded by Syed Imdad Ali at Muzaffarpur in 1868) added a few books on natural sciences (geology, botany, geography, natural philosophy), beside retranslating books already done by the Aligarh Society. The overlap was only natural given the common interests of their respective patrons and the paucity of scientific manuals.[83]

Vernacularisation of western scientific knowledge being the main objective of early popularisers most of the text-books were, at least during initial years, simple translation of the original English (western) versions. Gradually local authors, both Europeans and the natives, began coming forward to write original science manuals within the provincial context. Thus Captain Campbell, who had set-up his own iron-smelting unit and a laboratory at Salem, wrote manuals on meteorology and chemistry.[84] William O'Shaughnessy wrote a number of manuals of instructions for the use of artificers employed in the erection of telegraph lines.[85] James Watt, while a lecturer at the Hughli College, wrote a text-book on botany and later translated the same into Bengali.[86] Among the native authors a few have come to our notice. In Bombay, Subhaji Bapu wrote scientific books on Euclid, algebra, and trigonometry (all in Hindi).[87] Hari Keshavji Pathare (1804-58) wrote *Siddhapadartha Vijnyan* Sastra (natural philosophy), *Rasayana Sastra* (chemistry), and *Sastriya Jnanadarshana* (general science). In 1887 Syed Imdad Imam wrote a book on horticulture in Urdu, *Kitabul Asmar* (Bankipore, 1887). Three years later he wrote another book on agriculture, *Keemyae Zeraet* (Arrah, 1890). Radhanath Sikdar had contributed at least three parts of Smyth and Thuillier's *Manual of Surveying*, though his name was deleted in the second edition.[88]

Further analysis of the demography of scientific manuals will

provide some useful information as to regional variation in the growing popularity of science in nineteenth century India. Though authentic information on this subject is yet to come, we have some rough calculations. In 1857, for example, not less than 5,71,670 copies of 322 books are said to have been issued in Bengali from 46 printing presses including 9 books on natural sciences.[89] Again in 1875 the Calcutta School Book Society produced a catalogue of 1544 books in Bengali. The list included 112 books on mathematics, 61 on physical sciences and 99 on medicine. As for the regional distribution, out of the 4122 books published in all the languages in 1874 (348 *dealt* with science) only 219 were published in regional languages–86 from Bengal, 49 from Punjab, 30 from NWP, 18 from Bombay, and 14 from Madras.[90]

The selection process of scientific manuals for translation was based on a pragmatic rather than philosophical approach. The main criteria being the immediate utility of a particular text. Therefore, texts on agriculture and surveying were high on the priority list of various translation bureaus. In 1841 a Bengali translation of a small work, *Elements of Land Surveying,* was produced with a view that it would help local youths looking for a career in survey department.[91] Similarly with landed aristocracy being their major patron both the Aligarh and Bihar scientific societies took utmost care of the interests of their patrons. In addition to the concept of 'utility' another deciding factor was the emerging appreciation of 'science for the sake of knowledge'. Ramendrasundar Trivedi, a popular science writer found the technological gadgets (telegraph, telephone, dynamo, motor, electricity, steamships etc.) to be too 'small' and 'negligible' in comparison with the 'sublime ecstasy which truth seeker derives from pure sciences'.[92] There was, thus an apparent bias in favour of natural sciences at the cost of engineering or mechanics. Only Bengali book on engineering was Durga Charan Chakravorti's *Vishwakarma*, pub. 1886.

Further research is required on this issue with more details about the authors, particularly the natives, their backgrounds, source of inspiration, interests, and intellectual moorings. Did they propose assimilation of western knowledge at the cost of traditional (Indian) knowledge, both textual and empirical? Or, conversely, did they call for the revival of the ancient scientific glory juxtaposing it with the alien knowledge system? Such questions are relevant even for contemporary India as we see a vertical divide on the contents of text-books with regard to the ancient Vedic glory *vis-a-vis* the cultural assimilation of the later period.

'Getting Science Across': public lectures and experimentations

Public understanding of science, it is argued, is not only a rational way of taking science to the people. It also has strong political connotations: a greater understanding of science by members of the public would result in a higher value being placed on scientific projects.[93] In fact the main factor which had invited men of letters and men of skills to shun the classical norm of secrecy was their intention to appropriate a place for themselves in the burgeoning civil society. Their strategy was straight-forward: the larger the people appreciating their intellectual strength the better for their material comfort and social standing. The growth of public lecturing represents just one aspect of the complex pattern interviewing knowledge with commerce. Selling personal knowledge was increasingly accepted as a civil means to upgrade one's self-interest in a highly competitive world.[94] It was this self-interest on the part of the scientist-popularisers like Humphry Davy, Michael Faraday and T.H. Huxley that a great amount of their time and energy was devoted to bringing science into general culture.[95] The populist programme of Davy even earned him presidentship of the Royal Society in November 1820, in the face of a stiff resistance from academic scientists of the Cambridge culture.[96] Viewed from the stand-point of audience the informal, personal, private, and temporary initiatives (public lectures), proved more fertile than the universities and the corporations. The informal was, at the same time, not necessarily second-rate. Medical lectures in England were delivered by the cream of the profession.[97]

The British lecturing culture had captured the attention of both future colonial administrators and the visitors from the colonies. Sir Gilbert Elliot (1751-1814), the first Earl of Minto, was regularly attending H. Davy's lectures at the Royal Institution before his appointment as the Governor-General of India.[98] During his first visit to England in 1842-43 D. N. Tagore (1794-1846), the charming Prince from Calcutta, is said to have developed strong ties, among others, with Lord Brougham (founder of the Society for the Diffusion of Useful Knowledge). He took keen interest in the activities of the Society.[99] On his second voyage to England (1845-46) Tagore was accompanied by his youngest son Nagendranath, his nephew Nabin Chandra Mukherji and the four Bengali medical students going for advance studies. During their stay in London the two young men from the Tagore family regularly attended Michael Faraday's popular lectures at the Royal Institution. Nabin Chandra in fact took voluminous notes on electromagnetism and transmitted them in detail to Girindranath in

Calcutta.[100]

Back home in India the 'lecturing' culture began at the lecture room of ASB. It was soon noticed at the CBG where Roxburgh and his successor Wallich, the two leading Linnaeans on the periphery, would entertain a variety of visitors with their public shows of the Linnaean classificatory system and some interesting literary insights into the 'sexual' description of the plant kingdom. The latter 'adventurous schema' even caused some discomfort to orientalists like William Jones.[101] Capabilities to deliver popular lectures later became a matter of necessity and pride for the burgeoning class of college teachers. While seeking lectureship at the Calcutta Medical College, O'Shaughnessy offered not only to teach chemistry and making experiments with medicinal plants but also to 'give practical instructions to non-medical (Indian and European) students, on a variety of subjects including the chemical arts of dying, bleaching, calico-printing, distilling, sugar-refining, melting of ores and manufacture of drugs'.[102] A 'tolerable science populariser' as he was, O'Shaughnessy ensured that his scientific results were promulgated in technical journals, in public lectures, as well as in his teaching at the Calcutta Medical College.[103]

O'Shaughnessy's populist agenda drew the attention of Lord Auckland, the governor-general, who himself had wished to infuse 'a spirit of emulation and rivalry' in the bosoms of the people under his rule. On 8th November 1836 Lord Auckland hosted a 'scientific' party at the Government House' which was attended by 'gentlemen of scientific pursuits and attainments'. The day began with an exhibition of 'scientific' objects including drawings by Hodgson, McClelland and Cantor on zoology of Nepal, Assam and Bengal. Mr. Pearson, Curator of the ASB Museum, came with his Cabinet of insects - 'all rigidly criticised and surveyed'.[104] When Lord Auckland took chair in the evening, O'Shaughnessy exhibited a working model of a machine producing motive power by the application of electro-magnetic influence'. At another crowded table was J. Princep with his machine.

In the second scientific party held in Dec. 1836 O'Shaughnessy demonstrated, this time by experiments, the nature and properties of oxygen and hydrogen gases, and the composition of water by introducing them in a close glass vessel the inside of which, though clean and dry before the experiment, became dewy'. It was followed by J. Princep's live show of the 'intense heat produced and directed on different metals, by a jet of flame consisting of hydrogen and

oxygen gases'. Botanists did not stay behind. Wallich brought 'a most perfect Ross' microscope', through which one could see the circulation or living principles of plants. There were several other novelties on display, all entertaining the curious crowd.[105]

Next week (14th Jan. 1837) O'Shaughnessy 'performed part of the eighth (sic) series of Faraday's experimental researches'. On this occasion participation from outside was also noticed as several mineralogical specimens came from NSW.[106] Next meeting could take place only after three months (14 April, 1837). O'Shaughnessy showed the properties of carbonic acid, and its effects on flame and animal life. He also explained the defects in Davy's safety lamp with reference to 'carbonic oxide, carburet of hydrogen and the olefins gas or heavy carburetted hydrogen'. The party then moved to Dr. Princep's table where they were introduced to the working of a steam engine and its application to mechanical purpose'.[107]

A similar current was passing through other presidential towns. No meeting of the Bombay Literary Society, for instance, went without an original paper being read'.[108] So much so that some observers from Bengal had found the Bombay intellectual circle resembling 'more closely the elegant yet intellectual parties' of London.[109] Public lectures was also part of a strategy adopted by the mofussil scientific societies to take science to the people. The Aligarh Society, for example, had hired Dr. Kilkelly for monthly lectures on aspects of natural science. Dr. Kilkelly also performed actual experiments before his audience, mostly the local zamindars.[110] Some of the public lectures were also linked with ongoing hydrological projects. Thus while executing the canal irrigation plans in the North-West Provinces Baird Smith, the engineer associate of P.T. Cautley, started taking private engineering classes at Saharanpur.[111]

As for their relevance in science popularisation such scientific parties were much more than a simple display of mechanical novelties. Corbyn reported that the demonstrations would have excited many persons to study and research on scientific subjects who otherwise never would have felt their importance before.[112] Some other observers noted that the meetings activated 'a diversity of genius to the exercise of faculties which otherwise would have lain dormant'. Public display of machinery on the other hand, would have inspired 'what D'Israilli calls scientific industry'.[113] Demonstration was not always passive. Rather some of the participants initiated discussions and debate often resulting into practical modifications. When Dr. Ranken discussed his

plan for detecting shoals in the way of steam vessels in the third party held on 3rd January 1837, several of the scientific and nautical gentlemen suggested some modifications to the use of the apparatus.[114]

Science on display: museums, gardens and exhibitions

The basic premise of British colonial empire in India was the projection of the west as a superior race possessing superior technology and knowledge systems. The strategy was to convince the natives about the great intellectual divide between the two cultures. This they did in an effective manner arranging public shows of their skills and technological gadgets. They did not mind providing large subsidies or even a free distribution of their stuff. A hidden objective of this mission was to addict the native mind with the western stuff. The history of tea culture in India is a glaring example of such business strategies employed by the British colonial entrepreneur–rulers upon the unsuspecting rural and urban folks of India.

At technological level we find the Britishers popularising agricultural technology and exotic seeds among the Indian farming community through exhibitions and agricultural farms. The encouraging results of the experimental farms opened in Bombay and Bengal Presidencies for the propagation of American cotton seeds were noticed by many including Lord Auckland.[115] Besides, there were 'Experimental Farms' for the demonstrations of agricultural machinery. In Bengal such farms were opened in Sibpur, Burdwan and Dumraon. In Bombay, there was a Government Farm at Khandesh, in Madras at Saidapet, in the Central Provinces at Nagpur. There were farms in the N.W. Provinces, Oudh, Assam, Burma and Punjab.[116] At the Kanpur experimental farm several kinds of implements were manufactured and sold annually. The list of agricultural implements sold during 1888-89 included 84 ploughs (Watt and Kaisar), 22 pumps, 24 corn-grinders and 8 chaff cutters. Most of the machinery was adaptation from the European models. The pump, for example, was adapted from the one brought by Sir Edward Buck from Australia. It was then modified at the farm by W.J. Wilson.[117] Agricultural exhibitions were also organised for demonstrating improved machinery. John Lawrence's first public appearance in Calcutta was for the purpose of opening an agricultural exhibition arranged by the Lt.-Governor of Bengal, Sir Cecil Beadon. The machinery paraded at such exhibitions did not differ much from the stuff seen at an agricultural exhibition in England.[118]

Although such public shows did not attain great success, and in some cases the government had to abandon the 'experimental plans',[119] yet their educational effect upon the natives could not be ignored. Local zamindars are reported to have shown great amount of interest in the machinery displayed at Alipore in January 1864.[120] Business interest apart, demonstration of superior technology had cultural effect also. Exhibitions were a way of putting the inventor's property of skill on show and placing it in a new cultural context outside the workshop.[121] Visual demonstration of technology, as J.N. Hays remarks, 'whetted the public appetite for more information'. In early 19th century London private collections and displays of mechanical delights were part of a popular culture, later institutionalised in the form of the National Gallery of Practical Science (1832), the Polytechnic Institution (1838), and the Crystal Palace Exhibition.[122] Here visitors came not only from English countryside but also from the overseas colonies. The two Parsee ship-builders from Bombay who went there to study the technical details of steam-ships announced that 'if we had seen nothing else in England besides the Adelaide Gallery and the Polytechnic Institution, we should have thought ourselves amply repaid for our voyage from India to England'.[123]

Cultural effect of displayed knowledge during the pre-laboratory era came more clearly in the case of botanical gardens and natural history museums founded on the periphery. Conventional histories of these two premier scientific institutions are, however, mere commemorative volumes celebrating the centenary of specific institution. Both botanical gardens and museums lost their scientific and educational appeal when scientist turned to laboratories for microscopic rather than macroscopic enquiry. Such neglect coincided with the gradual disappearance of field naturalists as nature was confined to green-houses to be analysed by more sophisticated scientific instruments. Besides, the rise of public and private research institutes and the remarkable expansion of universities diverted resources and interest away from botanical gardens and the museums to other scientific endeavours.[124]

But in early 19th century both botanical gardens and museums served not only as repositories of exotic collections but also infused a taste for scientific discoveries, especially appealing the middle classes who had greater leisure, wealth, physical mobility and educational opportunity.[125] These institutions represented a public-friendly image of exploratory science giving further leverage to the scientist to earn self-respect and greater support for science.

Material and philosophical interests apart a major mandate of the colonial botanical gardens was the description of the vegetable kingdom and to communicate the same to the 'learned of Europe'.[126] So much so that Wallich was later criticised by some of the self-appointed peers like John McClelland for attending to 'more congenial and philosophical purposes' at the cost of the interests of general public.[127] But Wallich had also attended to the interests of general public, not only by distributing new seeds and plants, but also by his botanical discourses which were attended by absentee-landlords like D.N. Tagore and Radha Kant Deb residing in Calcutta. His lectures had turned botany into a household affair in Calcutta with many of the bhadralok families maintaining their own small botanical gardens, both for recreational purposes and to study plant life.[128]

The natural history museums, much like the botanical gardens, were visited by general public for various reasons. Among the common visitors a large number had been encouraged by the commercial ventures unfolding through the displayed materials. De la Beche introduced the Museum of Economic Geology (f. 1835) with the promise that 'those who wish to consult it will have a body of information presented to them, which may enable them to understand the proper conditions under which mining should be attempted in various distant parts of the British Empire'.[129]

Besides, obsessed as he was with the gospel of conquest, common Englishman visited natural history museums to confirm the conquest of civilised Europe over Nature in the East. But the museums had a educational role at least for the young visitors,[130] a very pleasing role hailed by the contemporary press, both in England and in India. *The Englishman* noted that 'Museums offered the easiest way of making science and scientific zeal known to the public'.[131] Susan-Sheets Pyenson has analysed the changing public image of N.H. Museums. While during the early 19th century their main focus was on mass participation, serving as 'cathedrals of science', by the end of the century that mandate was taken over by more committed assignment. Now museums began acting as 'temples of scholarship' for an elite group of scientists alone. The 'educational function' of museums began to refer to the specific needs of scholars rather than the rational recreation of the 'public'.[132] In India, Wallich found the natural history collections in the museum more useful for his own professional observation, against which new specimens, collected on expeditions or acquired

as gifts, could be compared.

Science for whom? Audience demography

Science popularisation is seen as a matter of interaction between two intellectually separated human categories, 'performer' and 'audience'. While the scientific labours of the performers provide the stuff for the history of scientific ideas, the reception of such performers by the relevant audience leads us to the role of scientific activity in the process of cultural change.[133] It is not the identity of 'performers' only that matters but the identity of the audience is equally problematic. 'Who the guys were' sitting below the centre-stage? How did they negotiate with the performers? J.V. Golinski has identified three 'ideal-types' of audience relations. In the first place there existed personal relations between friends and between patron and client. Then there are market relations, between an author and the purchasers of his book, the manufacturer and his clients. Last in the series are institutional relations operating through scientific societies, universities etc.[134] The identity of science audience could be revealed by revisiting the quality of knowledge communicated, the personal virtues of the presenter and the nature of interests associated with science.

In England and America 'patriotism and civic pride' constituted the two main appealing factors for enlisting popular support. While in England common Englishman found a natural ally in science to meet the intellectual and industrial challenge from the 'ancients', In America the emerging industrial bourgeoisie found science to be a strong element for industrial growth. In Edinburgh, on the other hand, major portion of audience was represented by the landed gentry who came to science to enhance their own economic power by increasing the rent-value of their estates. In comparison to the three examples of England, America and Edinburgh dealt separately by George Foote, John Greene and Steven Shapin,[135] the pattern of science audience in nineteenth century India was closer to the Scottish example. For most part of the century popularisers could not go beyond 'the charmed circle of gentility'. Men like Radha Kant Deb and R.L. Mitra promoted interests of the Agricultural-Horticultural Society out of self-interests. The demand for new crop knowledge and improved agricultural technologies was associated with the rent-value of their estates. Prospographical analysis will reveal that not many members coming to join scientific societies would be called scientists by training and livelihood. But most of them were interested in science in some degree.

Science on the periphery was sold both as an object of prestige and utility. Therefore, the first lot of audience was drawn from the top layer of a feudalistic social order. Rana Madhaw Singh of Rewa was persuaded by his friend Captain Wilkinson to allow the British surveying troop led by Captain Paton, the Surveyor, for completing the survey of the region falling under Rana's territory in the name of 'utility' of the project. Later Colonel Waugh managed to obtain the permission of the ruler of Kashmir, Maharaja Gulab Singh, for Captain Montgomerie's plans of surveying the territory.[136] Genesis of spontaneous popular interest in western science has been traced to the interest generated by technological gadgets the Europeans had brought in to obtain favours in the Moghul Court as well as from the Provincial Chiefs.[137] Princely romance with technology was still alive two hundred years later, rooted more in the social prestige attached with the idea of having something unique. Ghazji-ud-din Haider, the Nawab of Oudh, who created history by retrieving the condemned steam-engines after their initial failure on the Hooghly, did not have much material stake in river navigation. The fifty-feet, 8hp craft built by William Trickett for the Nawab was decked out on special occasions. The vessel is reported to have roared into the river waters to salute the visiting governor-general, Lord Auckland, when the later visited Lucknow.[138] Princely interest was not restricted to the technological gadgets. A genuine interest in other scientific projects like astronomical observatories has also been reported from the Courts of Oudh, Hyderabad and Travancore.[139]

Public interest in science is associated with its capacity to solve problems of general use. The more people-oriented science, the more closer it is to the general public. Different categories of science appealed to different set of audiences. While geology, botany, agriculture, mineralogy etc. were taken up by the landed gentry, chemistry, mechanics and geography were close to the interests of manufacturers. Materialistic interests began to draw public attention to the domain of science, especially during the first half of the nineteenth century, hailed by some observers as 'the Age of Enterprise' in Bengal. Riding on the gospel of progress new entrepreneurs like D.N. Tagore envisaged an ever-lasting partnership, not only between the Europeans and the natives of India but also between the European science and the human and natural resources of India. Tagore organised the first coal-mining company and the first steam-tug and river steamboat companies and was one of the pioneer railway promoters. His near obsession with technological marvels brought

him into contact with Charles Babbage. During his stay in England in 1842-43 and 1845-46 Tagore visited steam engine companies like Maudslay & Company and the Fawcett's Engine Manufacturing Company of Liverpool.[140]

In addition to the feudal princes who sought to build a romantic image of science, and the emerging class of entrepreneurs looking for new fortunes, there were others who followed the early pioneers. While the Asiatic Society attracted the attention of an emerging class of *bhadralok* in Calcutta it was different clientele in the case of the Agricultural-Horticultural Society. With its mandate for the improvement of agricultural resources of the country the society was attended largely by the landed aristocracy.[141] In 1829 the Agricultural-Horticultural Society had 97 members; 34 from Civil Service, 17 Clergymen, lawyers or medicalmen, 6 militarymen, 11 natives of rank, and 29 agents, merchants, planters etc. Its strength went up to 460 members in 1839: 98 from Civil Service, 69 from military, no medical officer, 20 law officer, 9 Clergymen, 14 Europeans of no particular profession, 7 hon. members, 85 merchants etc., 89 planters, and 29 natives.[142] The audience attending the scientific shows promoted by Lord Auckland were drawn from a mixed lot. While majority of them represented professional groups, the presence of ladies, 'the fair disciples of science', was always an added attraction.

The size and character of science audience can also be estimated from the number of subscribers to science periodicals. While debating the issue of launching science periodicals in India the colonials were little apprehensive about the success of the project. The usual fear was 'that it would not pay'.[143] 'Payment' in this case was, however, metaphoric, implying lack of required readership. Corbyn sought to clarify that 'there are at the present moment upwards of 700 accomplished and highly educated medical men' scattered all over India.[144] Public support had never been a problem. The fact was also noted by John McClelland when the *Calcutta Journal of Natural History* completed three years. The success of *CJNH* was hailed as an assurance of the 'sufficient encouragement on the part of the public for its continuance'.[145]

Any discussion on the historical evolution of a movement like science popularisation would be incomplete without referring to the motives, explicit and implicit, which encourage both the knowledge producers and knowledge gatherers to congress at a common platform. Personal relations or the patron-client relations were founded more

on the compulsion of mutual advantage and less on the principal of 'national improvement'. One can read this self-interest in the large 'corresponding network' operating between the centre and the periphery during the Banksian era. A patron like Joseph Banks, to paraphrase Golinski, 'used his political muscle to advance scientist's career, in an explicit trade-off for his advice and the entertainment of his philosophical speculation'.[146] Personal acquaintance did help in generating interest in science among the audience. D.N. Tagore's interest in the Linnaean botany was more on account of his personal relations with N. Wallich, the Supt. of the Calcutta Botanical Garden, than a penchant desire to assimilate the Linnaean knowledge. Again his acquaintances with Charles Babbage, Lord Brougham and Lord Auckland had encouraged Tagore to appreciate the industrial and intrinsic value of science.

In the whole process of audience participation it is further useful to gauge the colonial priorities. In the first place the local (native) audiences did not come through the process of natural selection. Rather the colonial state, in the name of retaining the caste-structure of Indian society, created its own category of audience from local communities. In the process they further deepened the cultural gap among various castes. In the beginning Lord Macaulay and his disciples desired to restrict western education to a privileged class, excluding the great mass of people. The CoD had instructed the Madras government in 1830 to concentrate on educating 'the higher classes' only.[147] Alexander Duff's whole scheme was also aimed at the 'influential classes'.[148] George Norton, the advocate-general reasoned that 'light must touch the mountain top before it pierces to the depths'.[149] Similar prejudices prevailed in Calcutta where the Sanskrit College (f. 1823) admitted only Brahmins and Radhi Baidyas, at least until 1863.[150] Not only in general education but in matters of science and technology communication also the most common colonial practice was only to 'excite a spirit of enquiry and of agitation under a controlled system...'.[151] Read in colonial context the practice appears exuding racial bias, but the bias was universal. Obsessed with 'gentlemanly' ethos the nineteenth century Englishman declined to entertain non-conventional classes. So much so that the English universities remained closed for working class students for most part of an otherwise 'liberal' century.[152] It was only around the late 1870s that a change in colonial thinking was noticed in India. The neo-liberal British colonial administrators were beginning to realise the importance of educating 'the generality of natives - to make a good

husbandman a better one, a good mechanic more skilful in his own craft..'.[153]

Science popularisation and contours of the 'Civilizing Mission'

A strong critic of the Public Understanding of Science agenda has developed over the assumption of a cultural divide it creates. The knowledge producers, it is pointed out, operates with a strong sense of class superiority. Sharing of knowledge with 'lower sorts' is backed by a hidden desire to control the mental faculties of the latter, assuring them in the process that science would result in their moral improvement.[154] Enduring the notion of 'two cultures',[155] where knowledge descends from top to bottom — from people of quality to the vulgar savage – the whole PUS agenda is found to be an act of aggression, offending the sensibilities of the recipient culture. In conventional histories of colonialism the public face of scientific projects is dismissed as a ploy to capture the imaginative powers of a hapless local culture. Construed as a civilising mission the scientific discourse was seen and advocated as an advancement upon corrupt and overcrowded regimes.[156] Commissioned by 'superior conquerors' and supported by the Whig social reformers the rhetoric of civilising mission ensured that knowledge generated by the dominant genius is handed down to the lower class. William Jones, before he reached Calcutta, was a member of the Whig circle which opposed Lord North's liberal policy during the American Revolution. Jones was himself swayed by the notion of European intellectual superiority. 'We may decide', he once wrote, 'on the whole, that reason and taste are the grand prerogative of European minds...'.[157] With this sense of superiority the Englishman launched a massive plan of 'civilising' the native mind through the 'promotion of European literature and science among the natives of India'.[158] Each and every developmental plan was dominated by 'a conservative preference for all that is western; that any thing that is good must come from the west'.[159]

Part of this civilising mission was constructed on the premise of British civility which was first noticed in the Parliament debate of the 1780s on the Indian affairs. 'The looters of Bengal, like the smugglers of Massachusetts', a loby of liberal apologists had demanded, 'must be brought under sovereign power', i.e. the Parliament.[160] The Rochingham faction and supporters of Lord North reminded Britain of its 'responsibility for the orderly, just and humane government of Indian peoples,—'the honour recently forfeited at Yorktown could be regained by enlightened rule in Calcutta'.[161] The younger Pitt called upon Britain

'to bring the inhabitants (of India) happiness and tranquillity', though his end aim was to maximise 'commercial profit' from India.[162] Edmund Burke articulated a theory of colonial trusteeship. The slogan was widely accepted especially in the face of recent failure of British governance in North America. Gradually the transplanted Englishmen began to believe that British civility laid on them a responsibility of 'trusteeship for the welfare of mankind'. In 1835 the House of Commons accepted a report from the Aborigines Committee reiterating Burkeian mandate that the British government was responsible for the welfare of its subject races even as it was responsible for the wealth of Englishmen.[163]

But the same sense of civil responsibility was missing at the India House where political compulsions loomed large over civic administrative matters. Diffusion of scientific reasoning, the raj sympathisers had told the statesmen at the India House, 'will establish the bond of union so much wanted between them (natives) and the European residents'.[164] Charles Grant also approved the plan in order to win the confidence of local people. 'Let invention be once awakened among them, let them be roused to improvements at home, let them be led by industry to multiply... the exchangeable productions of their country, let them acquire a relish for the ingenious exertions of the human mind in Europe... for art and science, and we shall hence obtain ... the supply of four and twenty million of distant subjects'.[165] Being 'superior conquerors' it was a bounden duty of the Britishers to promote the prosperity of India 'by diffusing discoveries in the mechanical arts...'. This, he hoped, would help to 'erect the fabric of our rule... on a permanent basis'.[166] There was some voice of dissent as well. 'It was morality,' Bennett wrote in 1843, 'not science, that was held to justify empires'.[167]

As for the recipients' precept of the civilising effects of western scientific culture it was marked by mixed feelings. While some were outrightly swayed by the charms of western achievements in science others followed a cautious approach. After the Mutiny some one from Barisal wrote a panegyric to Queen Victoria listing the rewards his countrymen had lately received from Her Majesty's benevolent colonial state. In addition to the general peace assured by the British civic values this gentleman was bewildered, among others, by the sparks of 'gaslight', the smoking steamer which had 'vanquished the pinnacle and the sailboat', the railways and the electric telegraph which had brought England and India closer to each other.[168]

Conventional writings on local responses during colonial regime emphasise the notoriety of certain leading classes, the Brahmins and the feudal chiefs particularly, for the penetration of western values and artefacts into an otherwise closed Indian rural set-up. The notion that 'affinity and endearment' to the British value system was restricted to a few castes or classes, the natural allies of the empire,[169] is nothing but simplicity of reasoning, to say the least. Even a progressive like D.N.Tagore was also illusioned by the 'civilising' effects of European settlers in India. Tagore had in fact envisaged a long-term partnership between the Europeans and the natives of India, albeit on equal terms. Yet he did not viewed India as the passive beneficiary of western civilisation.[170] At the same time we find many of his contemporaries, both Hindu and Muslims, Brahmins and non-Brahmins, appreciating the scientific achievements of the western world. Mirza Abu Talib (1752-1806) of Oudh, Shams-ul-Umarah (1783-1863) of Hyderabad, Abdur Rahim Dahri (1785-1850) of Gorakhpur, Sir Syed Ahmad Khan of Aligarh and poets like Mirza Galib and Altaf Husain Hali, they all had been unanimous in lauding the march of science in Europe and had further wished India to emulate the same.[171]

Conclusion

The empire-science problematic reveals a pattern of social appropriation of scientific knowledge through a process of interactive participation. Further research is required to re-claim the dialectic interaction between the performers of science and their audience. The other end of this debate opens into the disciplinary boundaries of public understanding of science and contemporary issues associated with PUS, especially its political implications. It would be wrong to believe that PUS movement is a modern development. A conscious effort in this direction was first made when science performers sought public legitimacy of their achievements. The challenge was thrown open by the growing networks in science. Here again colonialism, with its reliance on 'sophisticated' technologies and knowledge systems, emerges as a watershed in the whole history of relationship between science and its audience. In the 'Asiatic mode' of knowledge production knowledge was shared through common interest. There was thus no place for such specialised categories like science popularisers. Besides, with the economic interests being localised, the empirical interaction was sufficiently geared for the transmission of knowledge. It was only when the society opened up and the economic and literary interests of people went beyond their locality that a category of science popularisers became indispensable.

Future agenda of 'colonial' science is located somewhere between the 'imperialist' and the 'diffusionist' models. A study of the institutional organisation of science, scientific text-books, periodicals, public lectures and demonstrations will reveal, as we have suggested in this paper, the extent to which science was re-appropriated by the recipient society. While spelling out the future results of British rule in India Karl Marx had announced that being 'first conquerors superior', the British were 'inaccessible to Hindu civilization'.[172] Marx had thus sought to create an illusionary divide between the European 'superiors' and the natives of India implying categorically that the latter were lacking in their intellectual resources to comprehend the 'superior' social values, intellectual strength and scientific knowledge of the Europeans. Having said so Marx declined to appreciate the impending cultural dialectic between the two cultures separated over time and space. History has, however, proved Marx wrong. At cross cultural level western science was as much accessible to natives of India as the 'gentlemanly' science was to the English working class or colonial science to the first migrants in America.[173]

Contemporary observers like the French educationist F. Boutros had noticed, not only the emerging appreciation of 'the treasure of European knowledge', but also its rearticulation by local popularisers through the vernacular languages.[174] At times the originality of native ideas and their 'so much clever and spirited writing' did surprise the western elite. Cultural forces of colonialism, particularly the 'wonders of the age travelling into the East', had opened up new opportunities for the 'vulgar' natives.[175] 'Mild, pleasing, and intelligent' as they were, the 'parsimonious' natives of India proved to be 'most industrious and preserving' in their response to western science.[176] Soon its cultivation became their 'watchword'.[177] The culture of the superior conquerors, once thought to be beyond the reach of the bulk of mankind, was now pouring down to the third layer of the indigenous society. To appreciate the full implications of this response syndrome specific case histories need to be encouraged.

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Lamenting the Past, Anticipating the Future : A Chronology of Popular Science Writing in India (1850 - 1914)

Dhruv Raina

This paper commences with a discussion of the general features of popular science writing in the late nineteenth century. It goes on to highlight the aims of the activity, the role of textbooks in fashioning the new pedagogy of science, the problematic of translation, and briefly explores the issues of popularisation addressed by sociologist and historians of science. With this as a conceptual platform, the section on phases of popularisation rests on a critique of percolation models and transmission studies of the dissemination of the new knowledge. This critique draws upon the studies of Shapin and Schaffer [1] for its interpretive framework. The paper closes with a brief summary of popular science activity in pre-independence India.

The narratives of freedom

The social roots of popular writing on the sciences lie in an important political programme, and are traceable back to the impetus accorded it by savants such as Diderot, Laplace, D' Alembert, Condorcet and others as the locus of Enlightenment.

Diderot neatly summed up this agenda of the Encyclopedists: the aim of the Encyclopedia is to assemble the knowledge gathered over the face of the earth, to explain its general plan to men with whom we live, and to transmit it to those who come after us, so that the labour of the past centuries may not be useless to future times; so that our descendants by becoming better informed may in consequence be happier and more virtuous, and so that we may not die without having deserved well of the human race.[2]

The Utopian promise of this project was to find a concrete correlate in four related programmes, designed naturally to usher in Utopia. These had to do with the promotion of the experimental method in the sciences and industry. This evangelical programme was furthered by the belief that the benefits accruing from the use of the experimental method legitimated its extension to other dominions.

Further, that this new knowledge was a literate knowledge, and the cause of the civilisation of the future could only be advanced by the promotion of adult education. For the encyclopedists reason was to be the banner for democratic movements, and thus ran counter to the gain of the Church and state.[3]

Over the past two hundred years, the epistemology of modern science, its relation with the state, and the nature of the science-society relationship have all undergone rapid change.[4] However, during the period 1840-1910, the continent of scientific knowledge was simultaneously undergoing rapid empirical consolidation, theoretical unification, and disciplinary specialisation as a prelude to the expansion of the dominion of science. How were these changes reflected in the textbooks and pedagogy of science? To answer this question, we shall in summary fashion refer to some of the insights that have been gained through research into the diverse aspects of the history of science.

At the intersection of the pedagogy of science education and the history of science, some of the finest deliberations have come from a number of science teachers in Great Britain in the 1960s, who were examining the modalities for making science more attractive to an increasingly alienated student population. The Nuffield programme was one offshoot of these efforts. The core assumption of the programme appears to have been that an excursion into the history of the sciences would help disclose the context within which scientific knowledge actually emerged, and bring human beings back to the centre stage of scientific development.[5]

One of the most important vehicles for any kind of instruction within the formal system of education is the textbook of science. The sociologist of science, Thomas Kuhn's remarkable studies have revealed, contrary to the self-image of science, that science teaching is a highly dogmatic activity, for it is the most important way of including a paradigm among science students.[6] The science textbook offers an instructional manual for purveying what is considered established science. The importance of textbooks for the historian of science is that we have here a barometer for gauging the teaching of science in the past, which offers us a mechanism for plotting the evolution of scientific ideas from the past into contemporary practice. A feature about textbooks as we know them today is that they were never meant to be original, and that a mark of a successful textbook is that it goes through several editions.[7]

The historian of chemistry, David Knight, has proposed a typology of textbooks. To begin with are the classics or the great textbooks. An illustrative case would be Lavoisier's *Elements of Chemistry*, published in 1790. The book was never meant to serve instructional purposes, nor was it a work designed for self-education. As Knight points out, it was a work in rhetoric, a conspectus of chemistry seen through the eyes of Lavoisier. It divulges his own way of approaching earlier writing on chemistry and outlines a regimen for the performance of experiments.[8] While the work is a highly original classic it was not meant to be a textbook.

The prototype of the science textbook as we know it today emerged in the eighteenth century. These textbooks were prepared for courses in chemistry and medicine. In fact, Booerhave, Knight tells us, found that the lectures he was delivering at Leyden were being pirated; so he decided to put them down for his students. On the other hand, Thomas Thomson for the first time prepared notes for his students at Glasgow on Dalton's atomic theory. By the early years of the nineteenth century, the template of the modern science textbook acquired coherence. Textbooks came to be written for courses, for instructional purposes, and initially for students of medicine.[9] Two models of the textbook, shaping in fact the practice of medical science teaching, appeared. The first largely analytical, and the second illustrating the procedure of demonstration by experiment. These two models constituted the two pillars of the contemporary pedagogy of science the one relating to the 'pure' part of the sciences, and the other to the applied aspect.[10]

Further, in the first half of the nineteenth century, what are considered children's book today, were often used as textbooks. Typical examples are Jane Marcet's *Conversations in Chemistry* and Samuel Parkes' *Chemical Catechism*. These books were essentially compendiums of useful knowledge and reflections on the nature of divine providence.[11] The second half of the nineteenth century is marked by the revolutionary development of the science of thermodynamics. The law of conservation of energy provided the conceptual inspiration for the synthesis of hitherto disparate disciplines such as mechanics, optics, electricity and magnetism. Tait and Tait produced the first legendary textbooks that handled this synthetic view of the physical world.[12]

As the sciences advanced, the textbooks of instruction appertaining to these sciences became increasingly specialised.

Ironically, these specialised textbooks shared a synthetic view of knowledge and sought to bring the different branches of sciences under a common roof. Further, within this genre of textbooks, the truly great ones contained a history of the discipline. The nineteenth century masterpieces of chemistry stand out as shinning examples.[13] The authors of these textbooks did not intend to merely produce handbooks of technical instruction, but also establish the necessity and validity of naturalism as a philosophy of science. The authors also hoped to champion their views of what ought to be considered the mainstream of the discipline.

Transmission and translation: conjugates of an historiography

Textbooks of science were thus not merely instructional manuals but also cultural texts which conveyed messages that were nested in very complex ways. When we examine the history of science textbooks in nineteenth century India, a problem that is to be immediately reckoned with is how these textbooks manipulated their content to legitimate modern science. I do not use 'manipulate' in its pejorative sense, but wish to expand the meaning of the term 'translation', as encountered in studies in India on the history of science, from its trivial colloquial usage, namely that of finding equivalents for words in one language in another. In fact, it is fairly obvious that the notions of transmission and translation are conjugates of the same historiography of science. The law of three estates reveals how the two set the frame for a genre of science studies, for it points out that the transmission of knowledge is governed by a historical sequence of activities involving translation, assimilation and creative production.[14] As is evident to students of culture, the model is patently passive.

In more recent studies in the sociology of science, as well as of science in popular culture,[15] the term translation connotes displacement drift, invention, mediation, even the creation of a link that did not exist before, which in the process modifies two elements or agents. In addition, the historian of mathematics, Rashed, who possibly shares little with the insights of the social constructivists, suggests a differential approach to the study of translational activity. In this approach, translation is visualised as an activity that respects cleavages between the sciences. Gradually, the image of passivity is replaced by one of conversion, reactivation, and renewal of one or more disciplines.

Further, translation begins to make sense once it is situated against the backdrop of the complex relationship between the

translator's knowledge and the advancing frontiers of scientific research.[16] Thus in discussing translation there is the need to repeatedly examine from every subsequent vantage point in the history of ideas, the constant dialectic of translation and research. This would mean that we ask the following questions: (a) How is translation determined by the current state of knowledge, (b) when and how do translations of texts surpass the original, (c) Does scientific activity receive a fillip by the extension of translated works?

It is equally important to dispel another quotidian notion about scientific translation, or any act of translation for that matter. And this has to do with the misconception that scientific concepts are clothed in stand-alone words, and translation merely demands finding equivalents in other languages. As educationists as well as sociologists of science have long recognised, concepts are articulated within frameworks, and are embedded within clusters of related scientific propositions, within which they acquire meaning. Translation studies addressing the transmission of scientific knowledge, have thus far done grapple with the cultural dimension of translation or even with the dialectic of translation and knowledge.

A chronology of science in modern India

Drawing upon a framework developed within the sociology of scientific knowledge, we have tried to grapple with the theme of popular perceptions of science in the process of cultural redefinition. Our researches have suggested three phases in the cultural redefinition of science between the years 1850 and 1920.[17] In a recent paper on P.C. Ray, I have broached this issue, and shall cursorily recapitulate the same here. Towards the third quarter of the nineteenth century, the Indian intelligentsia, then at the periphery of the world of modern science, were seeking out an exemplar for emulation, in order to reduce the distance separating centre from periphery. Gizycki, in his discussion on the patterns of emulation at the periphery, is careful to point out that this programme is never one of mere imitation, but of adapting existing institutions, by drawing them closer to models drawn from the centre.[18] In order to appreciate this process of adaptation in institutional and cultural terms, three phases in adaptation have been proposed.

In the first phase of adaptation, the autodidact is a significant cultural agent, since he/she is situated in the indigenous knowledge systems, and is pedagogically instructed in the ways of modern

science. The autodidact assigns him/herself the task of setting the terms of the dialogue through translation activity, which could be construed to mean the translation of textbooks of modern science into the vernacular, be it from English to Bengali or Urdu or Tamil. But this would have required the production of a lexicon of metaphors and images that rendered the new world epistemologically refigurable in a frame that is recognisable and appealing. Further, the translation would also entail domesticating this knowledge through the invention of a revised grammar, and an argument that renders it legitimate. The genre of works of master Ramchandra, particularly his translation (in the quotidian sense) of the works of Todhunter, Tait and others,[19] and his translation (in the new sense) of the *Bija Ganita* into modern calculus, exemplify this tradition.[20] This effort was continued through Zakaullah (Habib) in Delhi, and a large number of autodidacts and school teachers elsewhere, who professionally were sensitising vernacular Indian cultures to modern science.

The scientist-cum-renaissance mind comes to the centre stage in the second phase. M.L. Sircar, the founder of the Indian Association for the Cultivation of Sciences, and university figures, such as J.C. Bose, Ramendrasunder Trivedi, P.C. Ray, and even so-called traditional scholars like Hakim Ajmal Khan, belong to this category. In their writings, traditional knowledge systems are examined critically but sympathetically, in the hope of revitalising, renewing and salvaging them as much as possible in the light of modern science. The previous generation had prepared the ground for their efforts towards science popularisation. But there is an important difference. In addition to promoting science and instituting procedures for legitimating their ideological programme in scientific terms, the scientist had become a partisan of the burgeoning nationalist struggle of the age.

Further, in journals such as *The Dawn*, there were debates on technical education and industrialisation and on the path of development best suited to Indian socio-economic conditions.[21] Simultaneously, in institutes of technical education, the translation of textbooks on mechanical engineering and other engineering disciplines was inaugurated in Gujarati by Ghaskadavi, and then in Marathi and other vernaculars.

By 1914, through the efforts of the purveyors of modern science from the first two phases, the modern scientific research system came into its own. The first Indian Science Congress was held in 1914. The peers of science in India had graduated that critical number of students

to ensure the further replication of the scientific research system. The choice of research problems in the exact sciences was now divorced from their cultural grounding, research problems were now defined by issues raging in the metropolises of science. This was the third phase.[22]

There is a remarkable difference in the popular representations of science in the three phases, which arises from the distinct historical location of the cultural agents, as well as on account of the rapidly evolving frontiers of scientific knowledge. Actually the differences are more marked between the first two phases and the third. Since we are concerned here only with a description of these formations, I shall evade the question of the politics of knowledge. In popular writing of the first two phases, there is a great deal of mobility between traditional and modern conceptions of the natural world, which is what makes these phases exciting areas for investigations into the cultural dimension of science. The tension between notions of modernity and tradition, within colonial discourse as well as within the world of the colonised, is most acute in these phases. In political terms, the leading edge of this tension is apparent in the ambiguity regarding the predisposition of the interlocutors to nationalism and internationalism.[23] As indicated elsewhere, the first generation of Indian scientists, while positioned within so-called traditional societies, approached tradition critically, in order to revitalise traditional systems of knowledge in the light of modern science. Gieryn has suggested that there are two coexistent repertoires in popular science writing. One is the repertoire of partial coincidence, according to which science and religion shared an overlapped territory enjoined by common values and goals. The other is of distinct institutional territories, where the maps of science and religion embody distinct and separate institutional boundaries.[24] These repertoires are manifest in Indian writing on science of the period. More importantly, Indian scientists while party to the freedom struggle from imperial rule, were committed to both nationalism, when it came to the question of self-rule, and internationalism, as the cultural imperative for the fruition of their scientific efforts.

The cultural studies of science seek to examine the process of acculturation, redefination, translation and domestication of modern scientific knowledge and practice in the indigenist idiom. This has entailed studies of popular representations of science. The term 'cultural redefinition' encompasses a civilisational finding relating to science, which denies percolation models sufficient explanatory possibility and rejects the axiom that the methods and verities of science are unattenuated by its cultural milieu. It could be said of

India that it is among the former colonies, where by the late nineteenth century, a section of the Indian intelligentsia embarked on a project of reinventing modernity, and since science was the beacon of reason on which modernity was apparently founded, the project of cultural appropriation required the recovery of the idiom of rationality from within Indian society's cultural resources.

Lamenting the loss of the pop-innocence of science

In conclusion it may be pointed out that popular science writing in pre-Independence India is fractured between the instructional frame (since it also had to meet a growing professional demand), and the evangelical frame which sought to win over as many converts to modern science so as to reinstitute a novel enchantment with the world. Within the instructional frame, though statistical data would be required to substantiate the point, a significant volume of writing preponderantly consists of translations of textbooks published in English, or are translations of clones of these works authored by Indians in English. There are a significant number of cultural translations, by that I mean efforts seeking to read the traditional in the light of the modern; however, these become rare after the 1930s.

It would be pertinent to ask why. For after 1914, scientists in India were choosing problems from a global basket. But did this decide the nature of popular representations? It appears today that the popular conception of science was overladden with the assumption, questionable today, that the content of science was not contaminated by cultural presuppositions.

As far as scientific evangelism was concerned, Baconian optimism (of science being the goose laying golden eggs) marks most writing. Further, while the community of scientists swore by and basked in the radiance of internationalism, by the end of the nineteenth century the virus of nationalism also spread, this would now prove benign and now fatal. In India, fortuitously, it coupled with the programme for the promotion of science. The Natesan series on the scientists of India starkly symbolises the national prestige that came to be associated with scientific accomplishment. Furthermore within the European context, a great deal of scholarship has revealed that this fundamental ideological notion was produced politically, when scientific and technological knowledge came to be considered as the measure of advancement of nations.[25]

As science passes its stations from the mid-nineteenth to the

early decades of the twentieth century, in cognitive terms, scientific knowledge, that swore by intuition and commonsense, becomes increasingly counter-intuitive. And science classics in the popular genre, such as Darwin's *Origin of Species*, all but disappear. The development of science and its subsequent mega-specialisation killed a genre of instructional popular writing in the sciences. The expository genre of science writing in the popular idiom came to occupy the centre-stage. Even in the early decades of the present century a scientist with great communication skills, such as P.C. Ray or P.N. Bose, was rare. And today leading scientists who are lucid and articulate are uncommon : Feynmans and Stephen Jay Goulds are an exceptionally rare species. And in the process, the much-mentioned beauty of S. Chandrasekhar's exposition of stellar dynamics is lost to the uninitiated public.

To sum up the argument, the inauguration of the era of big science, like the tryst with destiny, is coeval with India's efforts to freeing herself of the yoke of British rule. As other stratifications came to mark the science-society relationship, additional interlocutors were inserted into the hiatus that separated science from its public–the historian of science and the science communicator. May be this insertion was inevitable. In this dialogue between scientists and the interpreters of science, we may lament the disappearance of Darwin's *Species*. Yet, we would have to extol the efforts of those who seek to strike a balance between the demand for standardising science textbooks and the creative ideal of science, for the two are interlocked.

In any case, as far as this workshop is concerned, it would do well to rephrase Foucault, that we are condemned to produce discourses about the discourse of science. In the same tradition, it has been asked whether the science of the past could constitute a past of the science of today. This is another way of saying that the past of science appears different when surveyed from every subsequent watershed in the history of the sciences. If that be the case, the new interlocutors of science have come to stay.

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Part Two
Science on the Local Metropolis

Popularisation of Science in Bengal : The Pioneering Role of Rajendralal Mitra

Amitabha Ghosh

The introduction of English education and the spread of Western thoughts and ideas in the first half of the nineteenth century had a tremendous impact on Indian society. The educated Bengali subjected tradition and faith to the scrutiny of reasoning and realism. However, this also saw a section of the Young Bengal group accepting anything Western and almost rejecting everything Indian. This sweeping trend of Westernisation was gradually replaced by a sense of nationalism. Indians began to feel deeply that they had no real knowledge of the early history of their country. Without an understanding of the achievements of the past, no nation can sustain her pride. It was at this juncture that Rajendralal Mitra (1822 or 1824-1891) made his presence felt as the first internationally acclaimed Indian scholar.

In the annals of Indological studies, Rajendralal Mitra left an indelible mark amidst the equally or even more brilliant scholastic works of his predecessors or contemporaries on two counts. The first is of a symbolic nature. Rajendralal forced his entry into what can be described as an all-European monopoly of historicising the Indian past so as to highlight the gloom that had descended upon contemporary India and from which West alone could deliver us. Secondly, Rajendralal integrated social history, as embodied in manners, customs and ceremonies, and everyday life of the people, with his studies of antiquity, architecture and archaeology. It was no longer pursuits of insulated knowledge on the evidence of bricks and bones only.

A liberal definition will certainly label these pursuits as scientific. But the present paper will restrict itself mainly to the generally accepted notions of science and Rajendralal's efforts at its popularisation. There is no intention of projecting Rajendralal as a working scientist. Keeping in view the examples of Francis Bacon or Akshaykumar Dutta, it is evident that one can be a champion of science without being a scientist per se.

Rajendralal's concern for scientific and rational values was first reflected in his performance as editor of the two Bengali periodicals,

Vividhartha Samgraha and *Rahasya Samdarbha*. Before his selection as editor of *Vividhartha* in 1851, Rajendralal was a member of the committe for selection of articles for *Tattabodhini Patrika*. *Vividhartha* was highly praised by many stalwarts of the nineteenth century. Rabindranath Tagore at the time of writing his memoirs (1911 - 12) commented that no Bengali journal could rival Rajendralal's *Vividhartha*. The second Bengali journal, *Rahasya Samdarbha*, devoted to the propagation of science, culture, art and literature, was edited by him from 1863 to 1868.

What were the factors contributing to its uniqueness? Admittedly, it was the first illustrated educative Bengali journal. But beautiful line engravings apart, *Dig-Dursun*, the periodical of the Serampore pioneers, from its first issue in 1818 made a similar claim as regards the spectrum of coverage. Items of scientific and technical interest in *Dig-Dursun* ranged from coalfields through steamships to balloons.

Contrary to the expectation generated by its name, *Vividhartha Samgraha*, was not devoted to the cultivation of unrelated knowledge which is so very current today, be it through media quiz contests or books of knowledge sponsored by this or that popular brand. Though an encyclopaedia is also a conglomeration of information on a variety of subjects, it escapes the drawback of unrelatedness owing to the alphabetical nature of its entries. Since periodical is incapable of affording alphabetical order, it must subject itself to a system of structure, a coherent pattern, an ideology, to avoid becoming a disparate collection of facts and figures.

It was on this count, their allegiance to a specific philosophy of science, that both the journals edited by Rajendralal could ride over the problem. The editing principle of the periodicals was guided by the Baconian approach to science. In diametrical opposition to the Greek School of Socrates and Plato, who were proponents of 'science for pure knowledge's sake', Bacon first and foremost tried to emphasise the essentially practical side of the new scientific movement:

> I entrust men to believe that it is not a opinion to be held but a work to be done, and to be well assured that I am not labouring to lay the foundation of any sect or doctrine, but of human utility and power.

The first Bengali disciple of Bacon was Akshaykumar Dutta who was selected by Devendranath Tagore in 1843 as the first editor of *Tattabodhini Patrika*, the organ of the *Bramha Samaj*. However,

Dutta's passion for the natural sciences proved to be a bit too much for Devendranath to digest. Dutta lost the job in 1855, and Devendranath admitted, 'while I was searching for the relationship between God and myself, he (Dutta) was searching for the relationship between external objects and human nature.'

The very first issue of *Vividhartha* carried an apparently innocent item as a joke. It was a dialogue between two philosophers of *Nyay*. A chance encounter with an elephant in the dusk set them guessing its identity. The first philosopher was of the opinion that it was darkness chewing raddish. The second philosopher did not agree: 'In that case why is it flapping its ears?' The debate went on in this vein and after considering various possibilities that animal was a cloud, fiend, shadow of an object–they came to the final *mimansa* (conclusion) that it was nothing.

This humorous piece cannot be cited as a proof in itself of Rajendralal's adherence to the ideology of Bacon. The fourth volume of *Vividhartha* helps us to avoid inconclusive speculations because it carried an elaborate article by Satyendranath Tagore, sub-titled in English as 'Baconian System of Philosophy'. Socrates, Aristotle and Plato, according to Satyendranath, had spent their lives in speculations concerning whether this world is real or an illusion (*Maya*). Whether we are at all capable of fathoming the real identity of an object or how many ghosts can be accommodated on the point of the needle to perform their dance etc.

It is necessary at this point to briefly outline the implications of the teachings of Plato in the Indian context. Originating with the first formation of class societies, the fatal division between the manual arts and the intellectual quests, between the man of theory and man of action, as J.D. Bernal argues, was more absolute in Greece at the time of Plato than it had been in the ancient East. Now compare this with *Rahasya Samdharva*, written in 1867. Correlating the ideals of Plato with Sankara and his version of Vedanta, the article commented, 'Plato was Sankaracharya of Greece and as Sankara spread the teachings of Vyasa, so did Plato interpret the doctrines of Socrates'.

Prafullachandra Ray, the first historian of Indian science, arrived at a similar conclusion. A strongly entrenched caste society, he observed, with its disastrous degradation of the social status of technicians, craftsmen and other manual workers, was the main cause

of decline of scientific spirit in India. Also, it did not escape Ray that ideological and philosophical factors, like the world-denying *Mayabad* preached by Sankara, contributed to the decay of scientific temper.

Both *Vividhartha* and *Rahasya Samdarbha* transcended their promise. In addition to the expected quota of articles embracing botany, geology, zoology, ethnology, history, geography, art and literature, they also dealt with philology and modern technology. Social prejudices and belief in the occult were ridiculed. Even Bengali chauvinism was not spared.

Space constraints do not allow a detailed discussion of the merits of the popular articles on technology published in these journals. The editor definitely kept pace with recent technology developments. For example, the readers' curiosity about the electric telegraph was satisfied within a year of its introduction. The article also suggested a method for sending Bengali messages. Eighteen articles by Rajenderalal on the manufacture or processing of common articles of industrial nature, scattered over different issues of *Vividhartha*, ranging from candle to coaltar, were later collected and published as a book titled *Shilpik Durshun* in 1860. The article on tanning begins thus: 'Nowadays all the Hindus look down on leather as an unholy and ugly substance. But in ancient times leather was not an item of such despise ...and skins of cattles found many applications. In *Rig-Veda* there are references to water bags made of leather...wines were also stored in leather containers.'

Two more tributes to Rajendralal as an editor are in order. *Vividhartha* was the first journal which tried to foster the library movement in rural Bengal. It earnestly hoped that in the near future, libraries would replace the *chandimandap* as community centres.

Technological concerns

The spirit of Bacon does not permeate only these periodicals. Two apparently unlinked efforts of Rajendralal, the initiative taken by him in the formative years of the School of Industrial Arts and the Photographic Society of Bengal, also bear the strong stamp of this ideology. Rajendralal played a keyrole in founding the School of Industrial Arts in 1854, which is now known as the Government College of Art. This institution was instrumental in diffusing the arts and crafts of engraving, architectural design, lithography and photography. During the formative years of the institution, the organisers took pains to impress upon the students of the need to regard with respect and

honour the manual labour necessary for the practice of these arts. They did not fail to add that even if all the *Bhadralok* and the poor could be admitted into clerkship, it would not ensure the prosperity of the country.

Rajendralal also played a critical role in the introduction of photography into Bengal. He was one of the founder members of the Photographic Society of Bengal and for the first two years since its inception in 1856 held the post of secretary-cum-treasurer. In 1857 Rajendralal became politically active, when he made a speech in favour of the so-called 'Black Act', empowering Indian judges to try Europeans. This led to his expulsion from the Photographic Society of Bengal. The most undemocratic manner in which the infuriated white members got rid of Rajendralal, is a glaring example of imperial interference in scientific institutions. Aspersions were also cast on Rajendralal's proficiency as a practical photographer. The expulsion was followed by an almost *en-masse* resignation of the Indian members and the Photographic Society of Bengal was reduced to an ineffective club "for Europeans only".

Cartography & terminology

Rajendralal was the first to introduce thematic mapping and their use as a teaching aid. In 1854 he published *Prakrita Bhugole,* a book in Bengali on physical geography accompanied by physico-geographical charts and maps. It was followed by 'Bengal Atlas' (1871) believed to be the earliest extant attempt at cartography in Bengali. A series of 21 maps of the different districts of Bengal, it was conceived to meet the long felt need of the school students of Bengal, who were forced to memorise the descriptions of Europe, Africa and America but were denied the opportunity of learning anything about their own village, police stations or the districts. Rajendralal was meticulous about maintaining the correct spelling and phonetic purity of place-names. He could hardly imagine that in future we would become dependent on second generation maps, where 'Chandranagar' would be replaced by 'Chandannagar' after being transliterated from the incorrectly spelled 'Chundernagore' in English maps. Rajendralal not only spelled it correctly but did not also fail to add 'Farasdanga' (the land of the French) alongside the more popular name by which the town was then known.

Rajendralal strove for self-explanatory words and not transliteration or verbatim translation in formulation of terminology. He gave currency to many Bengali words including 'manachitra' for

map. Here is his own justification. 'Map comes from the latin 'mappe' – 'a napkin' and manachitra from *Ma'na* (measure) and chitra (a drawing) for the compound meaning – a drawing on a scale". In 1877 he published a pamphlet entitled 'A Scheme for the Rendering of European Scientific terms into Vernaculars of India'. It remains one of the most comprehensive scientific discussion of a problem which unfortunately can never be solved any more because the very idea of rendering higher education like medical science in Bengali or any other Indian language has been done away with. Rajendralal was strongly against the Anglicists' advocacy of the 'desirableness of having a common terminology for science the world over because' it should have the vernaculars.

He also considered whether or to what extent the vernaculars of India were capable of assimilating English, Latin and other foreign words. He writes, 'language of the same class can borrow very freely from each other, but from different classes they cannot do so to any large extent.....' English has borrowed most extensively and yet 'I doubt very much if any person would, for a moment, tolerate a proposition to put into it 20,000 Manchu, or Kamschatkan, or even Greek words in a lump.'

Scientific temper

Early exposure of the emerging *Bhadralok* of Calcutta with western manners, values and knowledge systems had resulted into a false sense of superiority among the Bengali intelligentsia *vis-á-vis* their neighbouring counterparts from, say Orissa or Bihar. Rajendralal rejected the Bengali chauvinism and promoted a rational attitude. In *Rahasya Samdarbha*, he printed poems by two foremost writers of Orissa, Dinakrishna Das and Upendra Bhanja, in parallel text form. In his introduction to Dinakrishna's poem, Rajendralal wrote, 'I have desisted myself from ascribing the article with the title `Oriya Kavita'. Nowadays anyone who tries to discuss anything pertaining to the land of Orissa, becomes a laughing stock of the Bengali community.' He would remind the Bengali chauvinists that 'when clusters of tiny insects like the muddy-shrimps is an item on our dish, we cannot disparage others for eating frogs.'

Rajendralal's style was straight and pragmatic. In his articles he would not attempt a practical explanation of how the miracle worker or 'guni' bluffs his audience. Instead, a healthy scepticism was communicated by adopting a hilarious style of presentation which in itself constitutes ridicule. The article 'Nectomancy' begins with a

historical outline of how the belief in paranormal powers led to witch-hunting in Europe. It was pointed out that the victims were invariably picked from the ugly, old, emaciated and destitute. The origin of the faith in the existence of such powers was traced back to Pythagoras and Socrates, who were not spared as in spite of their erudition, they pinned their faith in such supernatural phenomena. According to Plato, ghosts and demons acted as Socrates' bodyguards who gave him timely warnings. The article also commented upon Socrates' belief, still current in Bengal, that sneezing at the time of embarking on some project or leaving home is an evil omen. In a likewise manner, there were several articles in these two magazines which criticised *kaulinya pratha*, child marriage, polygamy, Ganga jatra, *antarjali* and *sati* as brutal evils.

Rajendralal's faith in the spirit of science was grounded in a wonderful sense of history and social evolution. Rejecting dominant social beliefs he would instead look into historical texts for truth. One of his articles in *Indian Antiquary*, titled 'Beef in Ancient India' was revolutionary. Realising that for the majority of his countrymen the title itself may be unsavoury. Rajendralal returned to the ancient literature, made a careful analysis of old texts, and concluded that beef eating was not at all banal in the eyes of Hindu religion.

Conclusion

Rajendralal was no firebrand social reformer. With his increasing involvement in the affairs of the British Indian Association, a platform of Zamindars, later years found him taking conservative views not only on political issues like that of permanent settlement, but also on social questions. In 1875, a meeting was arranged in the Hall of Maharaja Kamal Krishna to discuss the Age of Consent Bill. In the concluding speech delivered by Rajendralal, he made a brilliant analysis of the Hindu custom of marriage. He pointed out that in its earliest form of marriage—*rakshasa vivaha*—the forceful abduction almost amounted to rape. It was later replaced by the form most admired by Manu, that of gift or *prajapatya*. Rajendralal observed, 'there is no selection, no self-choice, no consent on the part of the bride, she is an article of gift, she is given away, even as a book or a picture, a cow or any other *chattel*....'

This profound analysis was followed by an unexpected recommendation. Rajendralal winded up his speech with a violent opposition to the concept of consent in a Hindu marriage because 'it does not enter into consideration when dealing with Hindu law'. And

Hindu law was sacrosanct : 'I cannot permit persons to claim Hinduship who will.not abide by the Hindu law.' He was also opposed to any idea of attempting contemporary interpretations of Hindu laws because 'whenever such interpretations have been attempted, they have given rise to new sects.'

This makes one wonder what kind of crisis turned Rajendralal against Rajendralal. But before we make a case for debunking Rajendralal, let us place him in a broader context.

It is fashionable in present-day scholarship to bring under scrutiny Bacon's conception of the unique validity of Western science. It is true that Bacon rejoiced over the acquisition of power by Europe over the rest of humanity, but when Macaulay and Rammohan Roy are bracketed together, and even Joseph Needham is accused of having latent racist ideas, deliberately confusion is created, with a view to sensationalise. Macaulay conceded that Bacon was one of the few imperial spirits whose rare prerogative was to give the human mind a direction it would retain for ages. But this had nothing to do with the considerations which encouraged Rammohan and, later, Rajendralal to introduce the Baconian system of education. For both of them, Bacon's significance lay in the relevance of his ideas to the context of the internal conflicts of Indian society. When Rammohan and Rajendralal advocated the introduction of Western models of science education, they were in fact motivated by the same considerations which later prompted Prafullachandra Ray to comment, '.....the spirit of enquiry gradually died among a nation naturally prone to speculation and metaphysical subtleties and India for once bade adieu to experimental and inductive sciences.'

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Ramendrasundar Trivedi : A Pathbreaking Populariser of Science in Bengal

Santanu Chacraverti

In the closing decades of the nineteenth century the Hindu -Bengali *Bhadralok* was attempting to shape a modernity of his own. He had gladly accepted the Orientalist verdict of the uniqueness and excellence of the Vedic-Vedantic-Sanskritic spiritual legacy and now sought his moorings therein, striving at the same time to adapt this legacy to the challenges of the modern world. The *Bhadralok* also readily admitted scientificity, science and science-based technology to be areas in which the West had triumphed and the East had succumbed.[1] However, disillusioned by the educational experience of the previous five decades, he had ceased looking up to the colonial government as the sole source of scientific enlightenment and technological advancement. Instead, the *Bhadralok* had begun to forge his own modernity — a largely Western derivative on which he sought to base his vision of indigenity. Witness for example, the Indian Association for the Cultivation of Science (established in 1876), or even more important, *samayikpatras*. These Bengali language periodicals embodied a new mood, a new mode of expression, and a new literary space, one which accommodated religious, aesthetic and literary criticism, philosophical explorations, and indeed science news and popular science articles.[2] Along with Bengali textbooks on science, it were these popular science entries which paved the way for the vernacularisation and at least partial indigenisation of Western science and scientific world-view.

Although he had able precursors, it was Bankimchandra's popular essays on scientific themes which demonstrated that Bengali prose could generate a linguistic space for an effortless discussion of scientific issues.[3] Admittedly, the prose of Bankim's essays on philosophical and scientific themes was not the language of the Bengali commoner, but one accessible only to the *Bhadralok* elite. Yet, it certainly paved the way for modern Bengali prose — which has a far broader base than could be imagined in the nineteenth century. Indeed Bankimchandra, and some of his fellow travellers in the world of *samayikpatras* created a new Bengali idiom, far less confined and

removed from common usage than Vidyasagar's and roomy enough to contain scientific and philosophic themes without bursting at the seams.

It was in the world of *samayikpatras* and with this new Bengali prose that Ramendrasundar Trivedi grew up. He was at home in the former and mastered the latter. And it was as an essayist that he sought to bring to his readers the fundamental concepts of contemporary Western science.

His first four articles, 'Mahashakti', 'Bibartan', 'Mahataranga' and 'Jada Jagater Vikash',[4] appeared in *Nabajivan* between 1884 and 1885 and marked his debut on Bengal's literary scene. All of them bore the stamp of a novice. Glib, verbose and relying too much on imagery, they served to be far less instructive than they could have been. The writer was after all only a young man of twenty striving for literary effect (on the writer's own admission, he had been impressed by the dramatic literary style of Kaliprasanna Ghosh;[5] Bankim's influence may also be discerned). But his fifth essay, 'Srishti Tattva' which appeared in *Nabajivan* in 1886, constituted a departure in science popularisation, not only from his earlier writings but from those of his predecessors.

The article explored the structure and the possible origins of the solar system. It drew on contemporary astronomical and astrophysical knowledge to provide an easily comprehensible, interesting and highly informative picture of the solar system. The essay converted themes such as the direction of the axial rotation of planets, the Titius - Bode Law of planetary distances, Helmholtz's problems besetting the Hypothesis, Plateau's experiment and other evidence, in favour of the Hypothesis. All in all, it was an eminently readable and instructive popular representation of developments in contemporary astronomy and astrophysics.[6]

The paper was not free from shortcomings. There were factual errors which were corrected in its subsequent publication. But in the later version, stylistic problems crept in. The original article, 'Srishti Tattva' had been divided into a number of sections each under a section heading. When it reappeared under the new title 'Saurajagater Utpatti' in the anthology *Prakriti*,[7] the section headings had been done away with. This gave the essay a less structured appearance and did not improve its pedagogic value. In fact, it set the trend for the style and structure of Ramendrasundar's subsequent essays, which will be discussed later in this paper.

Another aspect which distinguishes 'Saurajagater Utpatti' from 'Srishti Tattva' is the less formal character of the former. For example, in the latter, the Titius-Bode Law is mentioned by name (Ramendrasundar calls it 'Bode's Law'),[8] whereas in the *Prakriti*, version, the numerical principle is enunciated, but the name is dropped. This also is quite representative of Ramendrasundar's style, to which we will return later.

With the *Srishti Tattva* (1886), Ramendra was squarely launched on his course of science popularisation. During the next two-and-a-half decades he published a battery of popular science essays in the contemporary *samayikpatras* (*Sahitya, Sadhana, Bharati, Bangadarshan, Aryavarta, Punya, Pradip*, etc.). Most of these articles were compiled in the first and second editions of the *Prakriti and Jigmasa*, respectively. They were devoted to what were vital themes in contemporary Western science—electromagnetic waves,[9] non-Euclidean geometry,[10] debates concerning the age of the earth,[11] the theory of the continuity and variation of the germplasm,[12] the wave theory of visible and invisible radiation,[13] atomic theory,[14] the possibility of cosmic catastrophe,[15] gravitation,[16] light spectrum,[17] and the laws of thermodynamics[18] (the essay 'Uttaper Apachay',[19] devoted basically to the second law of thermodynamics, explained the principle of entropy increase in the universe and the intriguing concept of Maxwell's demon with charming clarity).

Ramendrasundar often utilised the historical approach in his popular expositions and some of his essays turned out to be popular discussions pertaining to the history of science. Splendid examples of this are the two essays entitled *Prachin Jyotish*,[20] one of which was first published in 1894, the initial publication date of the other being undetermined as yet. These articles provide a lucid and engaging exposition of ancient Indian astronomy — its strengths and shortcomings . They explain clearly to the lay reader concepts such as latitude, longitude, zenith, horizon, celestial equator, ecliptic and the equinoctical points, equinoxes and their precession. Another essay, *Panchabhut,* elucidates the concept of the five elements — or five ideal elements or categories as Ramendra would have it — and its logical/empircal status *vis-á-vis* modern concepts. The article, *Prakrita Srishti*,[22] first published in *Paush* 1301 BS (5 Dec., - Jan. 1894), briefly and succinctly traces the evolution of contemporary European cosmological theories.

Ramendrasundar's science popularisation efforts included a category of essays on the scope, method and spirit of science. In two articles, titled *Atiprakrita–Pratham Prastab* and *Atiprakrita–Dvitia Prastab*, and first published in 1893 and 1904 respectively,[23] he considers the problem of miracles, or the so-called violations of the law of nature, and examines the concept of natural law. These essays, upholding the principle of a sceptical, critical scientific method, are well within the confines of positivism, but nevertheless bring an unusually openminded approach into the discussion. The same spirit may be discerned in the article *Phalita Jyotish*,[24] first published in 1899, where Ramendrasundar advances the telling argument that the only way astrologers could get their claims to be taken seriously by the scientific community was by being prepared to submit their forecasts to a public, critical and statistical examination. His analysis of the concept of natural law bore interesting fruit in his essay *'Niyamer Rajatva'*[25] (first published in 1899). It stands out as a fine example of the sceptical temper of its author. The scientist, argues Ramendra, subsumes his observations under a summarising description and calls the latter a natural law. When facts come to light which contradict the above formulation, the latter is modified or rejected in favour of a fresh formulation, one which is able to subsume the new fact and is now in turn elevated to the status of a natural law. Given this procedure, asks Ramendrasundar, how can one ever hope to escape the realm of natural law? For if anything and everything that is observed to occur is subsumed under a formulation, and the latter is proclaimed a 'law of nature', then of course there can be no violation of this law. If science is concerned with describing what actually occurs, however strange such occurrences may be, and if the scientist is prepared to alter his description with every novel observation, then it perfectly explains the highly chequered career of natural law. And given the fact that it is the human mind which conceives of a description things and calls it 'law', need we be surprised at its existence? Need this fact throw us into raptures? And need this state of lawfulness prod us into imagining the existence of a transcendental lawmaker?[26]

All this is quite in the Human spirit, and more importantly, hints at Ramendrasundar's contention that scientific laws are nothing more than human constructs which help people to negotiate successfully with their experience (an approach Ramendrasundar appears to have imbibed from his reading of Karl Pearson and Ernst Mach). But a discussion of this theme would take us far afield into

Ramendrasundar's philosophy of science and his extraordinary work Bichitra Jagat, an enterprise beyond the scope of the present article. It only needs to be mentioned that Ramendrasundar dwelt on the philosophy and epistemology of science in many of his popular essays, most of which were compiled in the two editions of *Jigmasa* [27] which appeared during his lifetime.

Now we must refer to *Jagat Katha* — the most comprehensive of Ramendra's popular science expositions. Initial portions of the work were published serially in the *Sahitya* during 1910-11. The rest had been completed and the printing commenced when Ramendrasundar died (1919). It was carried out under the supervision of Jagadananda Ray, another of Bengal's famous science popularisers.

Ramendra Rachanabali, a collection of essay by Ramendrasundar published by the Bangiya Sahitya Parishat, runs into 288 pages.[28] Most of the chapter headings — 'The Material World',[29] 'The Three States of Matter',[30] 'Size and Shape',[31] 'The Problem of Measurement',[32] 'Solids',[33] 'Liquids',[34] 'Gases',[35] 'Pressure in Liquids',[36] 'Elasticity',[37] 'Gravitation',[38] 'Electricity',[39] etc.,—suggest a conventional physical science textbook, although titles like 'What is Matter',[40] 'Natural Law',[41] 'Observation and Experiment'[42] carry a different flavour.

For, the work deals with usual themes in a highly unusual manner. It is evidently addressed to the intelligent layman, who, while lacking the necessary scientific equipment, is nevertheless prepared to think for himself. Thus the chapter '*Jada Kahake Bale* (What is Matter?)' is not at all concerned with providing a part reply to the question; instead, it deals with conceptual difficulties involved in outlining an adequate definition of matter.

The object of the discussion in the abovementioned chapter is not merely philosophical but is germane to what comes a little later, when the author delineates the concept of mass. He wholly eschews the standard nineteenth century notion that it is a quantity of matter. Instead, he advances a more tangible operational definition of mass as the measure of inertia or a body's reluctance to accelerate[43] (in keeping with Ernst Mach's astute phenomenalist critique of Newtonian concepts). If this definition is less close to common intuition it is also incomparably less vague than the one in terms of quantity of matter[44] — a category notoriously difficult to define. And as Ramendrasundar hints in his discussion on 'Elasticity',[45] rigorously defined scientific terms may often depart from the usual intuitive meanings associated with them.

Having defined mass in terms of inertia, Ramendrasundar goes on to indicate the clearly conceptual difference between inertial and gravitational mass.[46] The former he calls *bastu* and the latter *bhar* [74]. Emphasising the distinction between them, he points out that logically there is no reason to expect their quantitative equivalence. Yet, he continues to argue, experiment shows these conceptually distinct categories to be equivalent. He goes on to note that one of the great achievements of Newton was that he experimentally demonstrated their numerical equivalence.[48] In fact, one of the prime concerns of the *Jagat Katha*, and indeed of the many popular science expositions by Ramendrasundar, was to clearly convey to the readers the distinction between what was empirically known — through observation and experiment — and what was conceptually developed or logically inferred.

As a positivist and empiricist it was his conviction that new discoveries in science can only be made through a procedure of observation-cum-experiment.[49] Ramendrasundar goes to considerable lengths—both in his *Jagat Katha* and in the last essay[50] of the second edition of his *Jigmasa* to—show that this numerical equivalence of inertial and gravitational mass was a surprising fact of nature.

This highly interesting exercise demonstrates Ramendra's feel for the crucial and his ability to convey the latter in precise and lucid terms. His discussion of the equivalence of inertial and gravitational mass was published in 1910-11, when he had no way of knowing that it was the peculiarity of this equivalence that had, sometime in 1907, set Einstein on the path of his General Theory of Relativity, [51] which would explain the equivalence of accelerating and gravitational systems. At the time Ramendrasundar was writing, few in Europe, let alone India, had any inkling of these momentous developments. Ramendrasundar was merely being guided by the critical tradition in European physics and his instinctive grasp of the essential which he felt duty-bound to convey to his readers.

This physical intuition and grasp of fundamentals is further evident in his treatment of 'Gravitation'.[52] He took great pains to dispel the notion that Newton or anyone else had explained the phenomenon of gravity which commonly manifested itself in the falling of things. Newton's great achievement, according to Ramendra, was his being able to link the terrestrial falling of bodies with the celestial motion of planets and satellites, under the universal principle of the tendency of bodies to accelerate towards

each other: and of the working out a formula for computing this acceleration in terms of the mass–values of bodies and the distance between them. But as to why bodies tend to accelerate towards each other, Newton could offer no satisfactory explanation. Postulating the action of a gravitational force or attraction was neither here nor there. For, said Ramendra, to say that bodies attract each other was no more illuminating than saying that they love each other or have passion for each other.[53] For this attraction or force was not an empirical fact; what certainly was an empirical fact was acceleration and the consequent pathways of objects.

All this was in the tradition of Berkeley and Mach[54] but surprising nevertheless. Once again Ramendrasundar had no way of knowing that a theory was being developed which would account for the pathways of objects in a gravitational situation without taking recourse to the concept of attractive force.[55] Ramendra was only writing for popular consumption, clarifying to his readers what was exactly and empirically known and what was not, and trying to purge their minds of what he considered to be unfounded and metaphysical notions.

In spite of the growing ill-health of his later years, Ramendrasundar tried to stay abreast of recent developments in science and keep his readers posted. He did not always succeed. (For example, he does not appear to have been able to keep track of new developments in atomic theory viz., the Rutherford-Bohr model, 1911-13). Nevertheless, the scientist Girijapati Bhattacharya expressed surprise that Ramendra was able to keep track of notions such as Fritzgerald contraction, mass-velocity relation, etc.,[56] at a time when books on relativistic physics were not available in India.[57]

Having described his work, it is time to assess Ramendrasundar's role as a popular science writer—his contribution and the impact he had. The opinions of some of his younger contemporaries would be relevant here although we shall eschew the florid and fulsome eulogies of Ramendra's many admirers.

That Ramendra's popular science writing acted as a source of inspiration for his younger contemporaries is evident from the famous science populariser Jagadananda Ray's statement that he looked upon Ramendrasundar as a mentor and teacher in the sphere of science writing in Bengali.[58] One must also refer to S.N. Bose's statement that Ramendra's staunch commitment to writing and reflecting on science

in the vernacular served as an ideal and guideline for the *Bangiya Bijnan Parishad.*[59] Indeed, generations had learned to delight in science from their reading of *Prakriti* and *Jigmasa.* These became for Bengali reader what the popular expositions of Helmholtz, Tait, Tyndall, Clifford and Mach had been for European readership. Girijapati Bhattacharya has reported that when he entered college (sometime in 1912), S.N. Bose, his friend and senior, had advised: 'Read the works of Ramendrababu. Such lucid and beautifully written expositions are not to be found even in English. They will give you access to many hidden alleys and secret closets of science'.[60]

What had Ramendrasundar achieved? In a nutshell, he, more than anyone else, successfully created for Bengali a linguistic space which could accommodate scientific, philosophical and epistemological themes without introducing any unnecessary artificiality or stiffness in the language.

This literary-linguistic revolution was related to his lifelong concern for Bengali language and literature and his studies in Bengali linguistics. Operating within the Vedic-Vedantic-Sanskritic framework, he attached great significance to Sanskrit, drew on it for generating scientific terms in Bengali, and, as Dr. Ramatosh Sarkar has aptly noted,[61] even employed lesser known Sanskrit words to succinctly convey images and meanings. But a nationalist venture seeking autonomy of intellectual expression could not afford to base its indigenity entirely on the Sanskritic legacy. Popularisation could only succeed through a comprehensible medium, and Ramendrasundar was prepared to respect the demands of the vernacular. As he asserted in one of his essays on Bengali linguistic questions, though related to Sanskrit, Bengali was an autonomous language with distinct claims of its own.[62] It possessed a large fund of non-Sanskritic words, and both usage and necessity required that such words be investigated and employed.[63] He himself did so with freedom, using at random words like *ojon, jinish, garam, karbar, ain, elaka, mamla, dalil, jajiati, jhagra* as well as popular expressions. As a result, his prose, though imbued with a Sanskritic flavour, never lacked the vitality and flexibility of a popular idiom.

It was Ramendra's object to bring the joys of science to all intelligent and moderately educated Bengali laymen. As he wrote in his inimitable style and intranslatable prose :

Madak drabyer ekta sadharan lakhya eije, aparke na bilaile anander purnata

hoi na. Bigyanamodio aparke anander bhag dite chan; na dite parile tahader ananda purna hoi na. Aparke metaite prabritta hoile takhan ar adhikari-anandhikari bichar chale na. Bhairabichakre sakal barnai dvijottam hoia jai, takhan jatibicharer abashar ghate na.[64] (The crux of what Ramendra is saying here is that just as the drug - addict's pleasure does not attain fulfilment until he is able to share it with others, similarly, one addicted to science must, in order to achieve full satisfaction, also share his pleasure with others, irrespective of their social or other privileges and accomplishments. The beauty of Ramendra's prose cannot be captured in another language nor can terms such '*Bhairabichakra*' which are meaningful only to a Bengali acquainted with his own tradition).

The vividly expressive prose quoted above indicates the nature of Ramendra's commitment to share with fellow Bengalis the fun, the delight and ecstasy of science, (in Ramendra's case, the themes and findings of modern Western science). This could only be achieved by dissolving alien terms and themes in an indigenous, flexible and comprehensible linguistic medium. Thus, when creating scientific terms, Ramendra took care to select words which had a sweet sound and could be easily pronounced, drew examples from mythology, folklore and local traditions (as the reference to the tantric 'Bhairabichakra' in the above passage demonstrates), cemented his prose with humour, lined his comments with mild irony, and talked of the gravest things with his tongue in his cheek. In this witty, sly, sceptical, gay and eminently human vein, he dragged science, epistemology and philosophy into the camaraderie of a Bengali *adda* and domesticated them on the couch of a *Bhadralok's* drawing room.

Yet having said all this, our discussion would be incomplete without mentioning certain features of Ramendrasundar's popular science writing which are problematic. First, in his popular science and other essays, the prose was repetitive, discursive and reflected the temper of a *majlishi* interaction. No doubt, such a casual conversational style has tremendous advantages—it breathes the spirit of live discussion into the corpus of dead prose, explores alien notions from different positions, and helps to indigenise them. On the other hand, repetition is not always a virtue: the reader is likely to get lost in the intricate tangle of circular arguments, picturesque analogies and casual digressions. Jogeshchandra Rai Vidyanidhhi criticised Ramendra's prose on this count, arguing that a reiterative style is very often an obstacle to clear and precise understanding.[65]

Indeed the discursive - repetitive mode resulted in a second and allied problem, Ramendra's essays did not lend themselves to being

broken up into sections. The latter, while introducing artificial divisions and depriving a theme of its polyphonic connections and implications, often renders it more digestible. It was only the formidable power and masterly clarity of Ramendra's exposition which usually prevented the discursive-conversational style from becoming opaque and confusing. Occasionally, Ramendra himself would become aware of this problem in his presentation and conclude it with a clear pointwise summerisation of the essential arguments.

Thirdly, the informal manner of treatment led Ramendra to stress themes rather than names. Obviously, he did not want to detract from the casual tone of his writing and burden his readers by quoting names. For example, noted earlier, the essay *Saurajgater Utpatti* appearing in the second edition of the *Prakriti*, describes the numerical pattern of the Titius-Bode Law, but omits any reference to its name. More often than not, he would write: 'scientists say ...' or 'some scientists have said ...' and omit citing the names. This has resulted in reducing somewhat the information content of his essays.

The fourth significant shortcoming of Ramendra's popular science expositions was the absence of diagrams (this criticism does not apply to some of his textbooks). In popular science expositions, the greatest clarity of expression and argument and the most picturesque analogies cannot render diagrams superfluous. But in Ramendra's time, Bengali popular science writers rarely included diagrams in their works, and Ramendra proved to be no exception. Perhaps, this had less to do with the inclination and awareness of the writers than with the fact that the *samayikpatras* could ill-afford the cost of preparing blocks.

Last, but not the least, is a question which applies nor merely to Ramendrasundar but to the entire genre of popular science writing in Bengal during his time. In what sense could popular science writing of those times be called 'popular'? In a situation where literacy was the privilege of a piteously small minority, and access to the *samayikpatras* and Bengali books was confined to the *Bhadralok* minority, the readership of popular science writing could hardly be the people. The problem continues even today, although the base of literacy has certainly broadened. Thus the science clubs of today, confronted with the reality of an illiterate and semi-literate majority, have to resort to audio-visual demonstrations and simple experiments comprehensible to the interested, if semi-literate layman. Indeed, writing as a medium for disseminating empirical information has its

problems. Live experimental demonstration will often, though certainly not always, be more instructive than repeated reading on the subject. But then Ramendrasundar was an essayist and a 'literature par excellence,'[66] who wrote on science as well as on countless other themes. He was not, and perhaps never aspired to be, an all round science populariser. So it is as a writer that he has to be evaluated and understood.

Notes and References

1. See Partha Chatterjee, *The Nation and its Fragments*, Oxford University Press, Delhi, 1993, pp.5-6.
2. For science entries in the *samayikpatras* of that period, see Buddhadev Bhattacharya, *Bangasahitye Bijnan*, Pashchimbanga Rajya Pustak Parishad, Calcutta 1880; and Benoybhushan Ray, *Unish Shataker Banglay Bijnan Sadhana* Subarnouchoha, Calcutta, 1987.
3. Most of which appeared on the pages of the *Bangadarshan* and were compiled in the volume entitled *Bijnan Rahasya* (1875)
4. Compiled in Sajanikanta Das (ed.), *Ramendra Rachanabali*, vol. VI, Calcutta: Bangiya Sahitya Parishat, 1363 BS, pp. 459-88.
5. *Ibid.*, p.267.
6. Ramendrasundar Trivedi, 'Srishti Tattva', *Nabajivan*, Sravan 1293 BS, pp.54-63 and *Nabajivan*, Bhadra 1293 BS, pp.79-83.
7. The essay appeared as 'Saurajagater Utpatti' in Ramendrasundar Trivedi, *Prakriti*, 1st ed., Calcutta, Ashwin 1303 BS, (1894), pp.1-16. It reappeared in the second edition of *Prakriti* (1909) shorn of printing errors. It is this version that has been included in, Bandyopadhyaya and Das (eds.), *Ramendra Rachanabali*, vol.I, 1356 BS, pp. 5-144.
8. See *Nabajivan*, Sravan, 1293 BS, p.55.
9. *Ramendra Rachanabali*, vol.I, pp.14-19.
10. *Ibid.*, pp. 53-56.
11. *Ibid.*, pp.20-26.
12. *Ibid.*, pp. 72-83.
13. *Ibid.*, pp. 107-14.
14. *Ibid.*, pp. 115-37.
15. *Ibid.*, pp. 138-44.
16. *Ibid.*, pp. 251-61.

17. *Ibid.*, pp. 293-307.
18. *Ibid.*, pp. 243-52.
19. *Ibid.*,
20. *Ibid.*, pp. 57-71, 84-93.
21. *Ibid.*, pp. 327-42.
22. *Ibid.*, pp. 33-43
23. *Ibid.*, pp. 199-207, 208-218.
24. *Ibid.*, pp. 353-69.
25. *Ibid.*, pp. 359-69.
26. *Ibid.*, pp. 368-69.
27. The two editions of the *Jigmasa* were published in 1904 and 1914 respectively. It is essentially the second edition, purged of printing errors, which appears in Bandyopadhyay and Das (eds.), *Ramendra Rachanabali*, vol.I, pp.149-455.
28. Bandyopadhyay and Das (eds.), *Ramendra Rachanabali*, vol.VI, 1357 BS, pp.211-499.
29. *Jada Jagat, ibid.*, p.211.
30. *Jader Tin Abasthha, ibid.*, p.213.
31. *Ayatan O Akriti, ibid.*, p.217.
32. *Pariman Samasya, ibid.*, p. 218.
33. *Kathin Padarthha, ibid.*, p. 215.
34. *Taral Padharthha, ibid.*, p.224.
35. *Anil, ibid.*, p.237.
36. *Taral Padarthher Chap, ibid.*, p.227
37. *Sthhitisthhapakata, ibid.*, p.222.
38. *Madhyakarshan, ibid.*, p.263.
39. *Tadit, ibid.*, p.459.
40. *Jada Kahake Bale, ibid.*, p.212
41. *Prakritik Niyam, ibid.*, pp.228 and 246.
42. *Abekkhan O Parikkhan, ibid.*, p.230.
43. *Ibid.*, pp. 255-63.
44. A related discussion, in the context of analysing the difficulties involved in generating a scientific terminology in Bengali, is to be found in an article by Ramendrasundar in the *Sahitya Parishat Patrika*, Magh 1301 BS, pp. 149-51.
45. Bandyopadhyay and Das (eds.), *Ramendra Rachanabali*, vol.VI, p.223.

46. *Ibid.*, pp. 252-58.
47. *Ibid.*
48. *Ibid.*, pp.260-62. See also, *ibid.*, vol.I, pp. 463-67.
49. *Ibid.*, vol.IV, p. 231.
50. *Ibid.*, vol.I, pp. 455-79.
51. See Banesh Hoffman, *Albert Einstein*, London: Paladin, 1986, pp. 107- 8., also, *Ideas and Opinions* by Albert Einstein, Calcutta : Rupa & Co.1984, p.287.
52. Bandyopadhyay and Das (eds.), *Ramendra Rachanabali* , vol.IV, pp. 252-55, 263-73. also, idid., vol.I, pp.251-61.
53. This analogy is not to be met with in *Jagat Katha*, although the basic argument is present there. The analogy is to be found in, *ibid.*, p.260.
54. For a brief treatment of Berkeley and Mach's critique of Newtonian concepts see Karl R. Popper, *Conjectures and Rebutations*, London : Routledge 1989, pp.166-74.
55. Hoffman, *Einstein*, *op.cit.* note 51, pp.105-20.
56. Srikumar Bandyopadhyaya (ed.), *Acharya Ramendrasundar Shata Barshiki Smarak Grantha*, Calcutta, 1973, p.105.
57. We have not taken up Ramendrasundar' s discussion of relativistic notions because they do not appear (except in an extremely fragmented form in an essay in the second edition of his *Jigmasa*) in any of his popular science essays but in a work pertaining to the philosophy of science, namely *Bichitra Jagat.*
58. Bandyopadhyay and Das, (eds.,) *Ramendra Rachanabali* , vol.IV, p. 210.
59. Ratanmohan Khan et.al.(eds.), *Satyendranath Basu Rachana Sankalan*, Calcutta: Bangiya Bijnan Parishad, 1399 BS, pp. 182-83.
60. Srikumar Bandyopadhyay (ed.), *Acharya Ramendrasundar,* pp.95-96.
61. Ramatosh Sarkar, *Ramendrasundar Trivedi*, (Makers of Indian Literature Series), New Delhi : Sahitya Akademi, 1993, p.19.
62. Bandyopadhyaya and Das (eds.), *Ramendra Rachanabali* , Vol.III.
63. *Ibid.*, pp.101-35.
64. *Ibid.*, vol.VI, p.433.
65. See 'Ramendrasundar Trivedi' by Jogeshchandra Ray Vidyanidhi, in the introductory pages of the *Ramendra Rachana Sangraha*, Calcutta Bangiya Sahitya Parishat, 1965.
66. Ramatosh Sarkar, *op. cit.*, pp.1-4

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Calcutta : The Bridgehead of National Science in Bengal (1876 - 1916)

Chittabrata Palit

Rammohan Roy was the herald of scientific education in colonial India. In his letter of 11 December 1823, to Lord Amherst, he wrote that the proposed fund of one lakh rupees created by the Charter Act of 1813 should be spent on scientific education. Opposing the move to set up a Sanskrit College, he made an appeal to the government to promote mathematics, natural philosophy, chemistry, anatomy and other useful sciences. This could be done by setting up a college furnished with the necessary books, instruments and other apparatus and by employing a few gentlemen talented and learned educated in Europe. [1]

But his voice was drowned in the raging Anglicist-Orientalist controversy. By 1835, Lord Macaulay's Minute on Education was carried to promote English education on a small scale based on liberal arts, with a sprinkling of elementary science.[2]

Mahendralal Sircar was born in the year of Rammohan's death (1833). He was truly a torch-bearer of the spread of scientific education in Bengal. Mahendralal went to Hare School and Hindu College. The elementary science component of the curriculum in Hindu College did not satisfy him. He did not share the view of his contemporaries who went to college for an English education and a career of clerkship with the government or the mercantile houses. He decided to join Calcutta Medical College in 1855, where a systematic, experimental science course were taught. With six years of his apprenticeship, he became a trained scientist, bagged all the prizes, and was awarded a LMS in 1860 and a MD in 1863. Initially, he set up medical practice in allopathy, but later switched to homeopathy for which he was professionally persecuted and socially boycotted by contemporary British doctors. In 1869 he started his campaign for a National Science Association by writing pamphlets and giving in public speeches.[3] In 1876 the Indian Association for the Cultivation of Science (IACS) was born. Mahendralal gave all his life's savings to it. Private donations from wealthy Indians followed, with which it was finally launched.[4]

In his first lecture on the desirability of a National Institution for the Cultivation of Science in 1869, Mahendralal advocated science and the scientific spirit to fight superstition and dogmatism and work towards national regeneration. He wanted his body to be entirely under native management and control in order for it to be self-reliant.[5] He was critical of colonial constraints on the spread of science and technology and pointed out that the government had not provided any opportunity nor any encouragement to Indians for the pursuit of science. Hence, a national alternative for scientific education was imperative.[6]

To the utilitarians who wanted applied science for vocational pursuits, Mahendralal pointed out that without an army of scientists who could teach the basics of applied sciences to would-be mechanics, the technical institutes would not be successful. His IACS was to be the nursery for such purposes. The hurdles were finally overcome, and the IACS was inaugurated on 19 July 1876. The government finally allotted it a building at 200, Bowbazar Street.

But his IACS also strayed from the goal. In his later years, before his death in 1904, Mahendralal Sircar became disillusioned. It was becoming another monolithic university and not a nursery for budding scientists, with the three-fold objectives of restoration of traditional science, assimilation of modern science, and popularisation of science for nation-building purposes. Still, the IACS was not founded in vain. Inspired by its example, Calcutta University soon introduced Honours and Master courses in science. Both C.V. Raman and K.S. Krishanan were for a long time associated with the IACS for their path-breaking research. The Association served as a model for other nationalist bodies coming up at this time, like the Dawn Society and the National Council of Education.[7]

Education at the turn of the twentieth century was 'over-literary, all-too-academic, unscientific and industrial.' It was marked by 'anti-national character and subordination to the British Government.'[8] A break with this system was sought by Satischandra Mukherjee, an eminent educationist, who founded the Dawn Society in 1902. Its mouthpiece, *Dawn* magazine started in 1897, carried about 40 scientific papers till 1912 to illustrate the progress of science and its applications. These included: 'Material Triumph of Science', 'Sidelights on Modern Science' (1897), 'Wireless Telegraphy 1902, 'Right Pursuit of Physical Sciences Considered from the Point of View of Individual as well as National Regeneration' (1902), 'Is Matter Alive : Some of the Latest

Researches of Jagadish Chandra Bose' (1902), 'New Alchemy' (1904), 'Chemical Research in Bengal', 'Indian Metallurgical Knowledge' (1912), etc.[9]

The Dawn Society held two weekly classes in the Metropolitan Institution in the evenings — one, a general training class and the other on moral and religious subjects. In the former, a variety of subjects were taught. The accent was on assimilation, and tests were taken for this purpose. In the industrial section, exhibitions and lectures were held. In 1903, K.B. Dey spoke on Japanese handloom and principles of weaving. K.B. Sen gave a talk on weaving technology in 1905. Goods produced in the manufacturing units attached to this section were put up for sale in various stores. Acharya Jagadish Chandra Bose, P.C. Ray, Ramendrasundar Trivedi, Nilratan Sarkar were associated with it.[10]

The great political upheaval unleashed by the partition of Bengal (1905) stirred up nationalist sentiments in the field of education as well. The anti-partition agitation, with its manifesto of boycott of British goods and constructive *swadeshi*, moulded the ideology of the votaries of national education and their advocacy of self-reliant science and technology for indigenous manufacture. The need for the spread of science from the school level to advanced research institutes was strongly felt by the prophets of *swadeshi*. On 16 November 1905 the landholders Association organised a meeting at Park Street which was attended by 1,500 delegates including eminent men of the time. The National Council of Education was mooted here. The spearheads of *swadeshi* and boycott in education were Rabindra Narayan Ghosh, Nripendra Chandra Banerjee, Radha Kumud Mukherjee and Benoy Kumar Sarkar. The boycott was intensified by the Rangpur incident on 3 November 1905. This occurred in the wake of the notorious Carlyle Circular of 10 October 1905 asking all magistrates and collectors to suppress students' participation in the Swadeshi movement. The circular was challenged at a public meeting on 24 October 1905, presided over by Barrister Abdul Rasul, and on 27 October at another meeting chaired by Rabindranath.[11] While Calcutta was simmering with discontent, the Circular hit the Rangpur Zilla School, as its students swore by the manifesto of swadeshi and boycott adopted at the Calcutta meeting of 24 October and sang 'Bande Mataram' in defiance of the circular. The Magistrate of Rangpur fined the ringleaders and expelled them till the fines were paid and threatened to close the school. The parents did not pay the fine and the students abstained from attending school.[12] The news reached

Calcutta on 4 November. A public meeting was convened at College Square, with Naresh Sengupta in the Chair and attended by Satish Mukherjee, Monoranjan Guha Thakurata, Hemendra Prasad Ghosh, Moulavi Leakat Hossain, amongst others. The Anti-Circular Society was formed and Ramakanta Roy and Sachindraprasad Basu rushed to Rangpur. The citizens of Rangpur held a conference on 7 November. On 8 November the first national school was started in Rangpur, with the object of imparting indigenous education, both general and technical. A 20-member executive committee was formed, with Umesh Chandra Gupta as President and Rash Behari Mukherjee as Secretary. Each member contributed Rs. 100 a month and raised donations upto Rs. 10,000 from various sources. The Rangpur National School started with about 300 students on its rolls. The local pleaders carried on instructions voluntarily and were soon joined by Calcutta graduates like Braja Roy, Nripen Banerjee and Hiralal Mukherjee. The birth of the National School sparked off the movement culminating in the formation of the National Council of Education. The order directing the flogging of a student of Madaripur High School and its defiance by the Headmaster acted as a major catalyst.[13] In a meeting held on 9 November 1906 at the Field and Academic Club, Subodh Chandra Basu Mullick pledged Rs. one lakh for the foundation of a National University in Bengal, with the following exhortation:

> I have known our own bastard system of education as well as the natural type of it in the west. It is a matter of great rejoicing that a great truth has at last dawned upon us today in all its glory... The attitude of the Government towards the students with regard to the present movement has been an eye-opener to us. We have seen what a dangerous weapon they can make of this control over education and secure career of national progress will be impossible for us unless we take away the same from their hands.[14]

For this munificence he was hailed as 'Raja'. As more repressions followed, the determination to found a national institution also got reinforced. On 11 November in a meeting attended by 10,000 students at the College Square, the Rangpur and Madaripur incidents were condemned and the need for a national university was discussed, among others, by Satish Chandra Mukherjee, Bipin Chandra Pal, Hirendranath Datta, and Moulavi Abul Hossain. The repression at Banaripara Union Institution in Barisal and the deployment of Gurkha troops there charged the atmosphere. At the call of Asutosh Chaudhuri to boycott Calcutta University, eminent men of the country were asked to rally on 16 November at the Bengal Landholders Association (in Park Street, Calcutta) for a conference to found a National Council of

Education (NCE) dealing with literary, scientific and technical fields – at an all India level and under national control. The meeting was attended by all the leading lights of Bengal viz., Gurudas Banerjee, Satish Mukherjee, Hirendranath Datta, Asutosh Chaudhuri, Rashbehari Ghosh, Rabindranath Tagore, Tarak Nath Palit, Chittaranjan Das, Abdul Rasul, M. Ispatain, Nilratan Sarkar among others. Apart from Raja Subodh Chandra Basu Mullick's promise of Rs. one lakh, Brajendra Kishore Roychaudhury of Gouripur donated Rs. five lakhs to the cause. A 15,000 strong gathering endorsed the decision to found the NCE the next day (17 November 1905), with S.N. Banerjee in the Chair and Rabindranath, Satish Chandra, Bipin Pal and Leakat Hossain present to grace the occasion.[15]

In the report of the Wages and Means Committee of the NCE, special emphasis was laid on (a) imparting scientific, professional and technical education (calendar 1906-08) chiefly in those branches of science, arts and industries which were best suited to develop the material resources of the country and to satisfy its pressing wants, and (b) inclusion in scientific education generally of a knowledge of the scientific truths embodied in oriental learning and medical education, especially those found in the Ayurvedic and Hakimi systems. Tarak Nath Palit who was intimately connected with the Provincial Education Committee and the Ways and Means Committee, refused to endorse the three-dimensional system of education and broke away to form the Society for the Promotion of Technical Education (SPTE). Rash Behari Ghose however, was the President of both. The NCE founded the Bengal National College and Bengal National School (14 August 1906), and the latter founded the Bengal Technical School (25 July 1906). The Technical School commenced intermediate (three year) and secondary (four year) courses in both theoretical and practical, mechanical and electrical engineering, ceramics, dyeing, soap manufacturing, tanning, technical chemistry, etc. It also had a manufacturing and repairs unit for motor cars, printing presses, and other instruments and machines. The Bengal Technical Institute started its career on 25 July 1906 at 92, Upper Circular Road (now University Science College). Among its first few principals were Pramathanath Bose, the famous geologist, and Sarat Kumar Datta, the pioneering electrical engineer who graduated from the University of Charlottenburg.[16]

The National Council of Education spawned most of the national schools in Bengal, particularly those in East Bengal (now in Bangladesh). The Rangpur National School (8 November 1905) and

the Dhaka National School (1905 December) were, however, precursors of the NCE itself. Up to December 1907, the number of such secondary schools came to about 20, of which 10 were directly affiliated to the NCE and were receiving its grants-in-aid of Rs. 40 to 125 per month. Five more were recommended for affiliation shortly thereafter. Some of these were located at Rangpur, Dhaka, Dinajpur, Chandpur, Mymensingh, Comilla, Kishoregunge, Magura, Majpara (Dhaka), Sylhet, Maldah, Khulna, Jessore, Santipur, Noakhali, Jalpaiguri and Kamargram (Faridpur). Besides, two free Primary National Schools were established at Baro-Bashalia (Mymensingh) and Dhap (Rangpur).[17] These efforts were effectively backed by the Bengal Provincial Conference held at Pabna in February 1908. Rabindranath Tagore, who presided over the conference, pointed out that control and direction by foreigners on education in India was a most unnatural phenomenon, not to be met with elsewhere. The aim and end of national education in India should be the fulfilment of the needs of the country. Arabinda Ghosh was even more categorical in saying that the university system was defective in its aims and methods, intended only to serve the purposes of the government and not the requirements of the country; one which turned out not men, but machines for administrative and professional work. The national system of education was intended to create a nation. It was producing men with well-developed faculties aimed at mental, moral and physical full of patriotism, the equals of the men of any other nation.[18] The conference then resolved to establish and maintain National Schools throughout the country for promoting a system of education—literary, scientific and technical – suited to the requirements of the country on national lines and national control.

Before the year 1908 ended, a few more secondary schools at Chittagong, Pabna, Kaligram (Malda), Jadupur (Malda), Dharampur (Malda), Habiganj (Sylhet), Arambagh (Hooghly), and Samtali (Dhaka) were founded, equipped with libraries and laboratories. 'Expert blacksmiths and carpenters' were appointed in many schools to teach and in some places, prominence was given to the teaching of the 'local industries to the learners'.[19]

As and when financial crises cropped up, the NCE arranged for grants-in-aid to these schools, with the clear direction that they be utilised for the specific purpose of development of the scientific and technical (S&T) departments of the three-dimensional system of education. The NCE stressed on S&T from the primary to the Vth standard in the national schools under its control. The NCE provided

Rs. 11,000 as grants-in-aid to secondary schools for the year 1908. Dhaka and Rangpur received the largest amount (Rs. 720); Comilla, Pabna, Kishoregunge, Jessore, Khulna, Noakhali, Rajshahi were all entitled to Rs. 600. Eminent educationists like Satish Chandra Mukherjee and Radhakumud Mukherjee, for example, inspected Rangpur, Dinajpur, Comilla, Chandpur, Dhaka and Mymensingh schools to ensure conformity to the ideals of NCE. A total of 89 candidates out of 167 examinees passed in the fourth public examination of the NCE in 1909. In the VIIth standard scientific course, all the nine successful candidates appeared from the Bengal National College. In the Secondary Technical Examination, all the successful candidates were from Rangpur National School; and in the Primary Technical Education, 12 belonged to Rangpur, six to Mymensingh and one was external. In Calcutta, the seat of this new learning, the NCE and the SPTE, the so-called traditional and modernised institutions, the former promoting science, in general, among other literary subjects and the latter technical education, in particular, as complementary institutions, failed to attract Young Bengal to their fold and status quo. As Benoy Sarkar writes :

> The Bastille of medievalism, anti-nationalism, non-scientific and non-technical literarism could not be subverted and so the tug of war between the two wings of nationalists, moderate and extremist, came by degrees to a close. It had found its measure as well as that of the other.[20]

But by 1916-17 it was clear that `not a student cared to come for a literary and scientific instruction along national lines. The institution that endured and survived is the institution of alleged materialism or 'bread and butter' philosophy, the Bengal Techical School. The Society for the Promotion of the Technical Education was, therefore, justified by (its) namesis.'[21]

Primacy of politics, repression, insecurity of job, lack of patriotism, paucity of fund – all conspired to bring it to a halt. With the coming of Asutosh Mookerjee as the Vice-Chancellor of the Calcutta University, an attempt was made to accommodate some of the objectives of the NCE, like the emphasis on national heritage and higher learning. By 1912 even Tarak Nath Palit for all his munificence, left SPTE to join University College of Science. The assimilation was complete. Still the Technical Department of the NCE persisted and continued to grow into what has now become the College of Engineering and Technology under Jadavpur University.[22] The spirit of the Bengal National College was also revived in 1956 when the arts and science

faculties were opened.[23]

Whatever be the vissicitudes, Calcutta as a nerve centre of national science and technology, relayed it to many rural towns in Bengal for the first time during the stormy years of 1905-11. The cause was not all lost in wilderness as one definitive work on the subject demonstrates beyond doubt.[24]

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Science Writing in Bengali : M.N. Saha and S.N. Bose in Contrasting Roles

Enakshi Chatterjee

Science writing in Bengali has a fairly long history. What is remarkable is the participation of eminent writers as well as renowned scientists in this venture. Bankimchandra and Rabindranath Tagore, Jagadish Chandra Bose and P.C. Ray – each wrote in his own way. Through their informative, romantic, and philosophic accounts of natural phenomenon, they tried to explain the why and how of things. Equally effective were Akshay Kumar Dutta, Ramendrasundar Trivedi, Jagadananda Roy, to name a few. There were even science journals in the nineteenth century specially targeted at women because the opportunities for their education were almost non-existent.

It is in the face of such rich and varied tradition of science writing in Bengal that the work of working scientists assumes greater significance. The essay reproduces the agenda of Meghnad Saha and Satyendra Nath Bose who had contrasting roles as popularisers of science in the vernacular. Both were eminently effective but their approach was markedly different. Saha wrote largely in English, though his earlier work happens to be mostly in Bengali. Bose on the other hand began late, but his entire output was in the vernacular. This itself is an interesting aspect and if we look at their family and background, it would appear to be even more so.

Born in 1893, in a small interior village in East Bengal, Saha came from a family of small traders. There was absolutely no tradition of education in the family except the barest minimum. The father wanted his son to help him in the shop. As a child, Meghnad was put in to the village *pathshala* but his father had no intention of spending money on his eduction beyond the primary level. Knowledge of history, English and other fancy subjects were going to be of no use in running the shop. But fate had other designs. Saha's teachers were impressed by his intelligence and insisted that he be sent to middle school. Saha too was determined to carry on his studies in spite of his father's opposition. To make matters worse, the nearest middle school was at Simulia, a village 10 km. away. Fortunately Saha won because his elder brother came to his rescue. He arranged for Saha's

accommodation in the house of a local doctor of Simulia. In exchange for staying with them, the young student had to do the household chores including the washing of his own dishes. Caste prejudices ran high those days. In fact, even in a Calcutta hotel Saha encountered the same discrimination from upper-caste boys.

From Simulia, Saha went on to Dhaka after winning a scholarship. This he unfortunately lost for taking part in anti-government demonstrations. However, to cut a long story short, his studies were resumed. He did his ISc from Dacca College and moved to Calcutta for his graduate and postgraduate studies. In a nutshell, Saha was never one to be put off by challenges. His interests were varied. Apart from mathematics, history and archaeology were very close to his heart. He came from a land of rivers, and had first-hand knowledge of floods and the havoc they created. For him, life consisted of hurdles at every step.

Let us now look at the very different social strata from which S.N. Bose came. Born in 1894 into a Kayastha household, very high in the caste hierarchy, his family was educated and cultured. Bose's father and grandfather were both government servants. They owned a house in Calcutta built by Satyen Bose's great-grandfather. Thus their links with their original village were severed long before Bose was born. He was in every sense a Calcuttan and had the urbane outlooks of one raised in a city. Moreover, being the only son in a family of six daughters, he was the centre of attention. His father, a very well - read man himself, saw to it that his son received the best education and put him into Hindu School for better competition. From his school days, Bose moved in the company of friends who also came from cultured families. Bose had access to their libraries, and was also exposed to music, literature and painting. He learnt French on his own, because it was the language of the elite. All his life he was in touch with the best of French literature. Bose also knew other languages, including German which was more out of professional necessity. In those days, the best scientific journals were in German and the paper which made Bose famous overnight came out in a German journal, translated by no less a person than Einstein.

The contrasting family backgrounds of Saha and Bose had great bearing on their future role as science popularisers. Saha's first Bengali article on a scientific subject came out in the Dacca College Magazine in 1910. It was the year of Halley's comet, and appropriately Saha, then a student of the ISc class, wrote on this subject. His next

contribution in Bengali came only after he had established himself as a scientist. His Bengali articles on 'Total Solar Eclipse in Norway' came out in the monthly journal *Prabasi*. They were remarkable for the lucidity with which he explained the phenomenon of eclipse. The composition of stellar bodies was of special interest to Saha; little wonder that he gave such an in-depth and fascinating account of them.

When Saha moved to Allahabad, he was asked by a friend to contribute some articles to a children's work in Bengali – Book of Knowledge. In spite of his busy schedule, Saha wrote a number of essays on the shape and position of the earth, the early explorers, X-ray, and other topics for children. Again, one is struck by the lack of pedantry and the total absence of technical terms. Saha always wrote when asked to, never on his own. At the request of Rabindranath Tagore he gave a lecture at Santiniketan on 'Modern Science and Religion'. This was subsequently published and provoked some orthodox thinkers. A lively debate followed, in which Saha had the last word in favour of modern science. For all his antagonism towards orthodoxy, Saha was well-read in all the scriptures. He had studied them with a vengeance. The reason for this goes back to an incident in his early professional life.

On a visit to Dhaka after he had made a name, an old acquaintance confronted Saha on his new theory. 'What have you discovered'? He was frankly asked. Saha, in the best of youth, tried to explain to him the Theory of Thermal Ionisation. But the gentleman interrupted him, saying it was nothing new. Saha was taken completely aback. The acquaintance explained that what Saha had told him was already in the Vedas. Thus Saha's discovery was nothing new. Saha pleaded him to specify in which part of which Veda did this theory appear? The gentleman insisted that it has to be somewhere in some Veda. 'But have you read the Vedas?' Saha demanded. The man said, 'No, I haven't, but it is in the Vedas, I am positive about that.' Saha realised that he was arguing in circles. Not to be outdone he went through the entire Vedic literature. Armed with this knowledge he set out to demolish dogma and blind faith. Later, he wrote an article, the title of which has now become almost a proverb in Bengali - 'It is all in the Vedas'.

Saha's Bengali writings, slender as they were, came to a halt when he was drawn to the political scene. He took up issues of all-India interest, the foremost of which was national planning. When his

friend Subhas Chandra Bose (a few years his junior in Presidency College, Calcutta) was elected President of the Indian National Congress in 1938, Saha was delighted, not because a Bengali had taken over the presidentship but because there was now a possibility of his own participation in national reconstruction. In the thirties, it was becoming increasingly clear that the days of the British were numbered. Most of the political leaders of the time were emotional about the issue and felt that all the economic problems of the country would be solved overnight once the British left. After a discussion with Saha, Subhas Chandra understood the enormity of the problem and decided to set up a national planning committee. In fact, Subhas Chandra too had been thinking along the same lines but was not sure of the best way to tackle the problem.

From national planning, Saha turned to other problems like river control, industrialisation, calendar reform, etc. Because he had first-hand experience of the plight of the poor, Saha was convinced that for Independence to have any meaning, it must transform society at all levels and raise the living standard of the common man. The Soviet model had a great appeal for him, and he wrote profusely in *Science and Culture* as also in other journals. After Independence Saha was elected an MP and was quite vocal on the floor of the house.

Consequently, from the thirties till his untimely death in 1956, all of Saha's semi-scientific and popular writings were in English. Here we find an interesting contrast with the writing career of S.N. Bose.

As mentioned earlier, Bose grew up in an atmosphere of culture. The literary clubs he belonged to, like the *Sabuj-Patra* or *Parichay*, were all very cosmopolitan in outlook. The journals these groups brought out were highly sophisticated. The editors wanted to break away from the conventional Bengali style to a more modern idiom. They wrote about the new waves in art and literature sweeping Europe, and were as French in temperament as they were Bengali. Satyen Bose took part in their meetings. Even after moving to Dhaka, he made it a point to attend the *Parichay* sessions. By that time the publication of *Sabuj Patra* had been discontinued. Curiously enough, he never contributed a single line to the *Sabuj-Patra* journal in spite of repeated requests from the editor. In desperation, the latter, Pramatha Chaudhury, is said to have remarked, 'Probably, Satyen feels more at home in front of a blackboard.'

The editor of *Parichay* was more successful in eliciting contributions from S.N. Bose. The first issue had an article by him entitled 'Crisis in Science'–an excellent exposition of the new quantum physics, with which Bose was deeply involved. On account of both style as well as content Bose never equalled his first contribution. One wishes he had written more in Bengali. Why he didn't, still remains a mystery. He did contribute a few more articles to *Parichay*, but none matched his early brilliance.

It was not that Bose was a reluctant participant. In fact, the meetings were made lively by his presence and small talk. It seems he was more at home in the informal company of friends than before the cold formality of pen and paper. He had tremendous love for Bengali language and culture, and supported the efforts of the *Parichay* group to bring to the Bengali reader a taste of the best that was being debated in the world of art, literature, and science.

Though he was not a prolific writer in Bengali, S.N. Bose acted as a catalyst on many occasions. The most important one was his indirect contribution to Tagore's one and only book on popular science. Tagore, quite late in life, surprised his readers by writing a short book on cosmology, called *Visva Parichay*, containing the latest information on the theories of creation. The book was dedicated to Satyendra Nath who was much junior to Tagore. Like all young people of the time, Bose held Tagore in high esteem. However, apart from a couple of visits to Santiniketan, the two were not as close as Tagore and Jagadis Chandra Bose had been. One wonders why Tagore dedicated his book to Satyendra Nath at all. The long dedicatory Preface explains it. It is a measure of Tagore's greatness that he expressed his gratitude to Bose through the book because, as he admits in the Preface, "I would not have been able to write this book without the active help and encouragement from your student Pramatha Sengupta." It was Pramatha Sengupta, then a teacher at Visva–Bharati, who was asked to write a book on this subject. Later, Tagore took over from him. It is quite clear that Pramatha Sengupta's first draft went through a lot of changes. But the fact remains that Tagore did not underrate the work done by Satyendra Nath's student. This fact is often overlooked by many, but Tagore himself acknowledged it. Thus, Satyendra Nath was indirectly responsible for the writing of *Visva Parichay*.

Then things began to change. Bose had to leave Dhaka a year before Partition. The break-up of Bengal was a cruel blow to him. In 1948, back in Calcutta, Satyen Bose became actively involved in

popularising science through the medium of his mother tongue. He almost became a crusader, quite contrary to the image of a shy and withdrawn writer of his early years. Whatever the reason, he alone was instrumental in forming the *Bangiya Bijnan Parishad* (Science Association of Bengal), with the foremost objective of propagating science in Bengali. A journal, *Jnan O Bijnan,* was also started, which has completed 47 years of its existence.

The purpose of the *Parishad* and the journal was to create an awareness about science, to foster a scientific attitude, and to provide the latest information in a simple language. This was a far cry from the *Parichay* phase, which was meant for a select few and, accordingly had a sophisticated and refined style. Bose was in a different role now. Not only was he aggressively vocal, he was, in many ways a path-breaker. Yet his was a lone voice, particularly in his advocacy of teaching science in the mother tongue in schools, colleges and even universities. But because of his name and stature, people did not dare to criticise him openly. He always evoked tremendous love and respect from the masses, though most of the people were only dimly aware of the exact nature of his scientific contribution. This fund of goodwill helped Bose in his mission.

A visit to Japan acted as an eye-opener. While attending an international conference there Bose was astounded to find that the most abstruse papers were in Japanese. Interpreters were available for the benefit of foreigners. Bose found that the Japanese scientists could express the most sophisticated ideas in their mother tongue. He enquired about their education system and came back home full of ideas. From then on he ceaselessly advocated the Japanese model, of how they had come up to world standards using only their mother tongue as their vehicle of expression. Bose even went to the length of suggesting the use of Bengali up to the postgraduate level. In his MSc classes, he gave lectures in Bengali, as also the Saha Memorial Lecture, just to prove his point. When some teachers complained of the paucity of Bengali textbooks Saha exhorted: 'Then write them!' With his support and encouragement, some very fine college level textbooks were written in Bengali.

Even though Bose himself did not write anything except stray essays and memoirs, he inspired others to write. The movement for the mother tongue took some time to gather momentum. The logic of Bose's argument was not immediately accepted. He insisted that no creative mind can flourish through an alien medium. Bose was pained

when he saw Bengali students spending considerable time and energy on learning English and trying to comprehend scientific material in a foreign language. In no other country in the world, argued Bose, does the student learn in a language not his own. The reason why Indian boys and girls were lagging behind was the unnecessary efforts made to master English. On the other hand, if they could read, write and think in their own language, the overall result would improve vastly.

The usual argument against this was that India is a multilingual country. Besides, science does not recognise geographic boundaries and in order to communicate with the rest of the world, knowledge of an international language like English, was necessary. Bose's answer to these arguments was that initially the child must be allowed to grow naturally. Besides, the knowledge of another medium, be it English, German or any other language, was needed only by a handful of those interested in pursuing higher studies and research in science. For general students, he argued, understanding the principles of science should be given priority. Learning the English language could come later.

In a brief survey such as this of these two stalwarts, one can only try to identify their areas of concern. Saha was more concerned with what he had to say, the content, not so much with the language. National issues, he felt, needed to be expressed in a language understood in all parts of the country. Of course, his target readership was the educated class, who would formulate policies and steer the country towards national goals. His Bengali writings, on the other hand, were of informative nature – to tell people of happenings during the total solar eclipse, what happened during Volta centenary at Como, Italy. But larger interests, that of national reconstruction and the need to educate the people who would be shaping the country's future, acquired greater urgency. Naturally, he could not persist with writing in Bengali.

Bose, on the other hand, was obsessed with the idea of giving the mother tongue its due place. Again in his own way, he too was concerned with what would be good for the country. A healthy mother tongue, he realised, would allow children to express themselves better. Thus though the two stalwarts differed in their methods, the end for both was the same.

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Part Three
Vernacularisation at the Local Peripheries

Ruchi Ram Sahni and the Pursuit of Science in a Colonial Society

Kamlesh Mohan

Ruchi Ram Sahni represents that generation of Punjabis which laid not only the foundations of middle classes in this region but also actively participated in the socio-cultural and intellectual fermentation, resulting from East-West encounter. Interestingly, the small number of urban mercantile families, who were exposed to the initial blast of western ideas and cultural innovations following the annexation of Punjab in March 1849 had also been obliged to reckon with the peasant ethos, oral tradition and popular culture brought by the sons (rarely daughters) of the ambitious village literate and rich peasants to the towns and cities of Lahore, Amritsar, Rawalpindi and Multan where they came for education and later employment.[1]

Apart from experiencing the tensions and contradictions in this peculiar socio-cultural melieu, Ruchi Ram as an Indian had also to carry the grievous burden of colonial domination. Creativity and leadership roles of this generation in intellectual, social, political and cultural fields depended firstly on their perception and awareness of their altered circumstances, produced by the colonial States' transformatory programme and policies under the banner of development and modernisation. Secondly, these depended upon the extent of their dissatisfaction with the traditional patterns of culture and intensity of resentment and apprehension aroused by the colonial hegemonisation through cultural and intellectual engineering.

These two points are equally relevant in any discussion on the cultivation of literature, arts and science under a foreign rule. Recent studies on the place of science in colonial projects have shown beyond doubt that science was inextricably woven into the whole fabric of colonialism. Both were locked into each other, sometimes in an inverse relationship. The state claimed superiority in terms of physical power, resources and race. Science, which claimed superiority in terms of knowledge, was ultimately co-opted by the colonial state and helped it to dismiss other epistemologies as primitive. Several colonial scientists felt uncomfortable yet they had to perform a dual role – to serve the colonial state and to pursue their intellectual calling i.e., the cultivation of science.

As social control was regarded as the pre-condition for the perpetuation of the politico-economic control and authority of the raj, the colonial sociologist, anthropologist and ethnographer joined hands to produce scholarly tomes and empirical studies about Punjab–its ecological conditions, cadastral resources, its multireligious society, institutions, manners, customs as well as religious and cultural traditions.[2] Under such compelling demands the national minded scientists had achieved distinction in their profession and partial success in popularising science mainly on account of their personal commitment, and creative energy rather than through state patronage. In order to appreciate the magnitude of their enterprise in a predominantly rural society of Punjab, we need to understand not only the common cultural framework of this region but also the role of the new catalytic agents, introduced by the British.

Socio-cultural melieu of Punjab

Ruchi Ram Sahni grew amidst a whirlpool of changes triggered by the installation of a new ruling elite, and the import of an equally new layer of experts, Indian but non-Punjabi. However, my intention in describing the socio-cultural universe of this region is to underline the shared aims of the movements for popularising science and for reforming religious beliefs, social practices and attitudes of the people i.e., to create a progressive society.[3] While the scientist used the discourse of rationality for enhancing common man's understanding about the working of natural phenomena and facilitate their productive control, the socio-religious activist and reformer made it an instrument for combatting polytheism, superstitious beliefs which had blocked the growth of individuality and reconstitution of contemporary society. In order to achieve their goal, both of them were required to understand the working of their societies in which they lived.

The socio-cultural universe which Ruchi Ram Sahni tried to challenge needs to be understood from the perspective of a total field of religion[4] as a common framework holding together its entire structure. The clientele of priestly religion despite its dependence upon scriptures, often traversed territory of popular religion, bowed to its presiding deities and sought their intercession in human affairs. In contrast the believers in saint cults, nature-gods, spirits and demons inhabited the rural tracts and gave no space either to scriptures or religious codes in their daily lives. More concerned with solving real life problems rather than enquiring into their causes the simple minded villagers

turned to a variety of sacred resources, evil spirits and sorceresses to rescue them or grant their wishes.

It may be pointed out that Ruchi Ram Sahni's drive for popularisation of science in this region could not ignore the dominant presence of peasant culture even among the western educated urban elite. A few empirical details about Punjab shall clarify the point. Punjab was predominantly an agrarian society in the nineteenth century. In 1881, 87 percent of its population lived in 34,000 villages and only 13 percent in urban centres.[5] The rulers and the ruled (excepting a small number of mercantile families) were dependent upon income from agricultural production. The colonial rule in Punjab did not dramatically alter the situation. Denzil Ibbetson, who had been associated with Punjab in various official roles, recorded that this region had neither vast towns and cities like Calcutta and Bombay nor great factories nor varied mineral wealth.[6]

For much of the nineteenth century, the majority of the Punjabis continued to live in an 'enchanted universe' to use Max Weber's phrase.[7] Dotted with shrines of *pirs* or saints, *jatheras* or clan ancestors, temples of disease–goddesses and other local godlings,[8] the Punjabi country-side attracted devotees from towns and cities. Among their devotees were included a large number of Sikhs, Hindus and Muslims. The explanation of their fervant faith in the miraculous powers of *Sakhi Sarvar, Gugga Pir, Sitala Devi* or *Suraj Devta* may be found in the popular perception of natural calamities, illness, disease and healing. In the pre-industrial society of Punjab, the people tended to attribute floods, drought, fire, famines and illness to the anger of nature pantheon, malignant influence of a diety or to possession by an evil spirit or demon.

Let us take examples of physical afflictions. In a peasant society, crippling arthrits and chronic rheumatism of joint are highly prevalent. Working for long hours on agricultural chores and handling farming implements were major causes of physical deformities among the cultivators. The inventory of illnesses for which cures were sought included intestinal disorders, eye-diseases particularly blindness, tetanus, leprosy, localised paralysis and psychosomatic disorders. As there was no well-developed public health system and medical science to treat diseases, psycho-social problems and to cure minor ailments, the unlettered peasants turned to supernatural forces, *sorcerer, ojhas, sianas* and astrologers.

Visits to the shrines of *pirs* (minor shrines) and *Khangahs* (major shrines) formed part of standard curative practices. These shrines catered not only to the spritual needs of simple minded rural folks but also provided cures to invalids from different denominations whose afflictions had often unknown causes and an uncertain prognosis. In performing their roles as healers, the *mejaweri* (successors of pirs who managed the shrine) did not undertake to establish the *aetiology* of any disease but to administer cures. All diseases were not treated at the same shrine. There was a kind of specialisation among different pirs and their shrines. For example, the main *khangah* (shrine) of Sakhi Sarovar at Dera Ghazi Khan had specialised in dealing with problems of spirit possession among women. The shrine of *Gugga Pir* at Bikaner, whose supernatural powers were invoked to grant wishes, heal the sick, protect cattle and bestow a son upon the devotee, specialised in curing his worshippers of snake and scorpion bites. Another example is of *Sitala Devi*, the goddess of pustular diseases who was worshiped all over Punjab by Hindus and Sikhs alike. Denzil Ibbetson, the chief ethnographer of Punjab, has recorded the therapeutic rituals to appease the goddess in the nineteenth century Punjab.

The observers of Punjabi society are struck by the absence of confrontationist approach to nature among the rural (even urban) people in the nineteenth century.[9] One reason is the impact of cultural socialisation which inculcates as a friendly and respectful attitude towards natural forces. The second reason is the availability of favourable ecological conditions on the whole as compared with the cold and harsh climates of European countries. Naturally, the Punjabi peasantry showed no inclination to control or dominate nature and their environment for individual and communal needs. That was why village gods were assigned important roles both in life cycle and agrarian cycle, particularly at the time of harvesting and sowing of crops. Apart from emotional bonds among their devotees, these godings were instrumental in protecting them from diseases, threats from outside world and evil spirits. For example, local godlings Bhoomis, represented by a heap of stones and generally placed on the boundaries of a hamlet, was invoked to protect the land on which village was settled.

Nature worship was also an important constituent of popular religion. In its pantheon was included Sun or the *Suraj Devta* as the major planet to be propitiated, the lesser ones being the Mercury and

Mars. Earth was widely venerated as Mother i.e., *Dharti Mata* because the rural folks were heavily dependent upon fertile soil for abundant agricultural crops. Another god in this pantheon was Khwaja Khir, the water god who rules rivers and streams. His favours were invoked both for protection from floods and adequate water for irrigating fields. Evidently, the relationship between the local gods and peasantry, for whom the village and its immediate environment represented the entire cosmos, was crucial in his day to day experiences.

It may be conceded that the popular religion and priestly religion had worked out a comfortable relationship over the centuries, implicating a process of mutual give and take. With the growth of the middle classes under the colonial rule, the reciprocal influence of the cultures of the powerful and the subordinate acquired a new angle. The popular culture, especially the oral tradition of the numerically dominant peasant population, circulated freely in the small towns and the big cities through the English educated sons of the village literati who acted as a bridge between the priestly elite culture of the urban areas and the rural culture.

Interestingly, this generation of the new elite also represented the rationalist critique and offensive against the Brahminical domination and excesses, rigid social hierarchies based on caste as well as against superstitious faith in magic cures, saint cults and sacred sites associated with village religion. Influenced by the enlightenment ideology, they tended to regard science as the 'pioneer instrument' for all progress.[10] The socio-religious reformers of the period also shared faith in scientism and utilised it as a weapon to counter missionary attacks upon their religions – be it Hinduism, Islam or Sikhism. Without going into the details of the reform process, I wish to emphasise that rationalists like Ruchi Ram Sahni and Mahendralal Sircar, who had been trained as scientists, tried to understand nature of their societies wherein they had sought to popularise science.

Ruchi Ram Sahni, well-known commentator on Punjabi society, colonial culture and national policies, informs us that the religious boundaries were not rigidly drawn in the nineteenth century Punjab. Even in the urban areas, majority of the people did not see any clash between the tenets of Hinduism and Sikhism. Recalling his formative years, he observed, 'my religious beliefs were as fragile and indefinite as that of my father, but in my case atleast there was a distinct leaning towards the tenets of Sikhism'.[11] He worshiped idols and recited *Rehras* and *Sukhmani* with equal fervour. Ruchi Ram Sahni attributed

the prevailing ambivalence towards religion to liberal socialisation in the family rather than scientific or rational thinking. The accommodative spirit of the Punjabis owed in large measure to the absence of Brahaminical dominance in a peasant society which valued the jats for their utility in an agricultural economy, despite their low status in religious hierarchy. It was reinforced by the egalitarian teachings of Sikhism and their large scale conversion to the new creed.

Gearing towards change : The new social forces

The foregoing description of the mid-nineteenth century Punjab has underlined the prevalence of polytheism, superstitious supernaturalism, a diluted version of caste system in the absence of socio-economic ascendancy of Brahmins and the other discriminatory social practices. This conservative social environment, which had slowed the pace of innovation in thought and practice including science and technology was to experience tensions when exposed to European ideologies and institutions. Among the various catalytic agents, which affected the mindset and behaviours of the Punjabis, the major ones were the western educational institutions, print culture and the Brahmo ideology.

The first major catalyst was the western education system, introduced with a two-fold objective : utilitarian and ideological. Macaulay and many of his contemporaries believed that miitary conquest had only won them a precarious hegemoney. The most enduring and the profitable conquest was over mind. It acquired even more urgency in the case of Punjab which had to be through mind. The colonial mission was an instant success as the first generation of Indian intelligentsia in the nineteenth century Bengal began to believe that it was only through the medium of English education that the reservoir of European scientific knowledge would be open to them. Raja Rammohan Roy and many of his contemporaries, regarded Britain as the chosen instrument for leading India to the path of political and economic modernisation.[12]

The British rulers were keen that this ideological perspective should be effectively publicised in the recently annexed Punjab which had to be converted into a secure but also profitable possession. Obviously, a serious missionary effort for the spread of western education, including literary and scientific, was made in order to colonise the consciousness of Punjabis.[13]

Lahore was chosen as the centre for administrative and educational institutions. By early 1870s, it had developed into a typical

colonial metropolis and by 1880s became the hub of cultural life of the north.[14] Possessing abundant resources, imperial aura, educational facilities and employment opportunities, it attracted young Punjabis thirsting for new knowledge in arts and science, eager to experiment with new gifts of the raj and willing to embark upon new careers. Many among them like Ruchi Ram Sahni, Lala Lajpat Rai, Gurmurh Singh and Bhagat Lakshman Singh were destined to become prominent intellectuals while others earned educational degrees in the hope of prosperous futures but lived in anonymity.[15]

These new intellectual elites were the product of a network of western educational institutions including anglo-vernacular schools of arts and science and engineering and medical colleges in Lahore, and other cities and towns of Pubjab. The opening of the first Government school in 1851 at Amritsar was followed by a chain of such institutions at Rawalpindi, Gujrat, Shahpur, Multan, Jhelum and Jalandhar. By 1856, there were thirty- five such schools.[16]

The next major landmark in the development of western education in Punjab was the opening of Government College in Lahore in 1864 which taught courses in Arithmetic, Algebra, Euclidean Trigonometry, Conic Sections, Logic, Economis, English, Persian, History, Physics and Chemistry. Under the principalship of G.Waletner the college emerged as a major educational institution. It was here that Ruchi Ram Sahni, first as a student and later as a faculty member, was drawn to the western scientific ideas. His concerns and sensibilities, particularly a real love and admiration for English language as a noble vehicle of thought and feeling,[17] matured in the company of his fellow students. As a student he also demonstrated his passion for western scientific knowledge, technologies and his ability to improve cheap alternatives for experiments and lantern slide demonstrations for public lectures.

The second western innovation was the printing technology which had facilitated the exchange and circulation of books like any other commodity. Described as '*print culture*' by McLuhan,[18] such a phenomenon transformed the Punjabi society which was based on oral and scribal knowledge, into a society where printing technology became crucial for the reproduction of ideas and knowledge. Thus, printed word became not only a source of ideas and images but also a bridge between scholars, scientists, students, social reformers and rural gentry. Easy availability of books, tracts, journals and newspapers had excited the imagination of students who could go beyond the

prescribed text books and familiarise themselves with European ideas on liberty, humanism and rationalism.

The eager students of Government College, Lahore, spent their leisure time in discussing, examining and scrutinising the implications of social theories and relevance of European ideas and scientific knowledge for shaping modern India. In his memories, Ruchi Ram Sahni recorded an illustration of one such stimulating reading session.[19]

> The remarkable books, as they appeared both to Guru Dutt and myself, we also read together in our spare hours in the college veranda, or rather the vestibule. These were Mill's 'Utilitarianism' and Bentham's 'Theory of Legislation'. They were, of course, not included in the college 'Course', but that was of little consideration for both of us. We read and re-read Mill's small book line by line, or paragraph by paragraph....Now and again, we could not do more than a sentence or two in the course of an hour, for either we could not agree as to what the author's real meaning was, or for some reason, the whole time was taken up with discussion about all the implications of the passage or how far we could accept his lead. Now and again, we would deliberately take up our stand on opposite sides, so as to be able to thrash our point as well as we could. As on such occasions, I would, as a rule, undertake to support the experimental view-point while Guru Dutt would become the exponent of the *Transcendental* school....Sometimes 'these discussions were attended by elderly persons from the city interested in one or other of the contestants. Now and again, the debates became quite animated and heated, each party pleading for his own thesis'.

Obviously, these eager students, who matured under the influence of the enlightenment ideology during 1880s and 1890s, had evinced a great admiration for Europe's achievement in literature, political theory and practice of democracy, positivism, scientific knowledge and technology. Their intellectual growth acquired more flesh when they came into contact with the English educated Bengalis in Lahore who had already internalised the discourse of scientific rationality of the raj. The earliest evidence of the application of modern scientific rationality to reform Indian society is found in Raja Rammohan Roy's *Tuhfat-ul-Mowahidin* (1803) wherein he has tried to define a rational theology.[20]

The third important catalyst of the socio-cultural melieu in Punjab was the Bengali Brahmo community which had provided a large number of clerks, teachers, pleaders and doctors as the human underpinning of the raj. Having crystallised as a social force, it played a crucial role not only in altering the traditional patterns of social and economic hierarchy but also in changing habits of mind among the

literate classes. During the 1880s, Brahmo Samaj and its creed was the major ideological influence upon Punjabi, particularly Hindu consciousness. Ruchi Ram Sahni became a regular member of the Brahmo Samaj within a couple of years after his arrival at Lahore as a student in October, 1879. Among the other youngmen who turned to Brahmo Samaj, were included Devi Chand Gupta(better known as Shradha Prakash Deva), Bhai Sunder Singh, Bhai Harbhagwan, Bhai Chatter Singh, Pandit Girdhar Raj Biswasi and Chander Prakash Deva.

Ruchi Ram Sahni's decision to study science and assume the role of a crusader for scientific awareness was influnced to some extent by his close involvement in Brahmo Samaj activities in Lahore. To the Bengali Brahmo intelligentsia and their Punjabi brethren-in-faith like Ruchi Ram Sahni, science connoted certain values: unity over diversity, the compilation and successful application of useful knowledge about men, society and the universe, the search of natural laws, optimism about the vital role of science in progress.[21] Brahmos not only appropriated science and rationalism in a special way but also deified them. Brahmo scientists were the first modern scientists in contemporary India particularly in Bengal.

Most Indians, especially Punjabis, despite their resentment against the domination' of Bengali Brahmo elite in educational and administrative institutions of the raj and religious life for almost half a century, continued to regard Calcutta as an intellectual centre. For many of them including Ruchi Ram Sahni residence in a big city like Calcutta was in itself a 'continuous source of education'.[22] It proved to be useful in two-ways. Firstly, his interest in Chemistry grew into a passion under the inspiring guidance of Professor Sir Alexander Pedler in the classroom and laboratory of the local Presidency College where he was a student. While assisting his teacher in his work as an Analyst to the Calcutta Municipality, Ruchi Ram acquired training in testing wines and methodical preparation of reports in a short time. As a student, he had not only formed life-long association with his aforesaid intellectual mentor but also with his class-fellow Ashutosh Mookerjee who rose to be the Vice-Chancellor Calcutta University later on.[23] Upendra Kishore Roy Choudhary, his class-fellow in M.A., strengthened his Brahmo sympathies. Secondly, the idea of his future role as a crusader for scientific awareness crystallised while listening to the public lectures of Professor Jagadish Chandra Bose, P.C. Ray and Father E.Lafont in Indian Association for the Cultivation of Science, Calcutta.[24] This Institute's role inspired Ruchi Ram to set up the Punjab Science Institute in collaboration with Professor J.C. Oman, his

colleague in Governemnt College Lahore in the summer of 1885.

Ruchi Ram Sahni's crusade for scientific awareness

Dissemination of scientific awareness in a colonial society implicated theoretical understanding of the subject, ability for its practical application and demonstration and a talent for lucid transmission of factual knowledge to the people with an average intelligence in their own idiom. Even more serious was the lack of organisational/ institutional structure to aid the popularisation of science among the people. Establishment of as many as 170 colleges including several medical and engineering colleges and technical education institutions (affilliated to the five universities – Calcutta, Madras, Bombay, Lahore and Delhi) and ten scientific services had only trained and employed Indians as clerks, second-rank technicians, and engineers to run railways, shipping or canal construction ventures or to gather informtion about botanical, zoological and mineral resources.[25] Transfer and relocation of western scientific knowledge and technologies was only partly successful in terms of long-term benefits to the Indian people. It was so because these ventures were conceived of and remained as mere technological projects which did not target at diffusion of knowledge and skills. Indians were educated to a certain point and culture of technology was withheld from them.[26] As colonial subjects, non- Europeans including Indians were denied opportunities for enterprise, investment and experience. It is evident from Rai Bahadur Ganga Ram's bitter experience who was discouraged not only from making investment on lift-irrigation technology to harness water near Renala in Lower Bari Doab canal but also deprived of contract to consruct tube-wells on his plot in Upper-Chenab Colony.[27]

Painfully aware of the conflict between the colonial agenda of scientific development and needs as well as aspirations of the Indians Ruchi Ram Sahni launched his mission for the transfer of scientific knowledge and grafting of technologies. It was difficult for any Indian to get state patronage or funding for projects concerned with dissemination of scientific awareness. Hence, paucity of financial resources made Ruchi Ram Sahni's task as a crusader for scientific awareness, indeed, daunting.

Despite all these handicaps, Ruchi Ram Sahni took the first step towards his goal by establishing the Punjab Science Institute in 1885.[28] The idea of this Institute had originated with Professor J.C. Oman but it took a concrete shape after Sahni had seen the working of the

IACS. Founded in mid-1885 with Professor Oman as Honorary Secretary and Sahni as Joint Secretary, the original aim and object of the Punjab Institute was the popularisation of all kinds of scientific knowledge throughout the province by means of lectures (in English and vernacular) illustrated with experiments and lantern slides, as well as the publication of tracts. These objects, according to Ruchi Ram Sahni, were expanded to include the encouragement of technical education, and, in particular of chemical industries.

In pursuance of the original object of science popularisation Ruchi Ram Sahni managed to involve several Professors from local colleges in the activities of the Insitute especially in its lecture-programme. For example, Professor Oman delivered several lectures on various aspects of 'Electricity' and 'Magnetism'. Dr. C.C. Caleb, who was on the faculty of Medical College, Lahore, gave a series of lectures on human anatomy. Caleb's two lectures 'Man's Fear' and 'Smokes: Poisonous and Non-poisonous', became especially popular. Dr. Grant's lectures on 'Soap Bubbles', 'Chemical History of the Candle' and 'Spinning Tops' were particularly well-received. Sahni himself gave as many as five hundred popular lectures in various towns of Pubjab and repeated these in private gatherings on personal invitation from local elites. His lectures on weather with special reference to India were based on sound and practical knowledge which he had acquired in the course of his job as the second Assistant Meterological Reporter to the Government of India.

Public lectures arranged by the Punjab Science Institute aroused tremendous interest among the residents of Lahore especially among students who had enlisted their parents as active supporters of the Institute. As a result, Sahni received invitations for lectures from the *rais* of Patiala, Kapurthala, Mandi and Bahawalpur. Besides, he used to give a regular annual course of twenty lectures on the basic facts and principles of Physics and Chemistry to the large audiences, consisting entirely of shop keepers. Ten lectures were devoted to general topics such as 'How Does the Telegraph Wire Speak', 'The Common Flame', 'Electroplating', 'Electricity in the Service of Man' (a series of three or four lectures), 'Glass Making' and 'Punjab and its Rivers'. The last one was illustrated by a large relief map of India (Made in clay under Sahni's direction for an Educational Exhibition at Lahore]. Several of these lectures, especially those giving advanced information, were repeated in Lahore city itself and also in a few small towns. Ruchi Ram's tireless crusade for the popularisation of

science created 'a real furore of enthusiasm in the province about scientific studies.'

Indeed, the personal commitment and concerted efforts of Ruchi Ram Sahni and his associates, particularly Professor Oman and Dr. Caleb, had succeeded in arousing interest in popular science among the people. The Punjab Science Institute, which had been substituted by the newly established Society for the Promotion of Scientific Knowledge, founded by local Medical College students in 1905, had been able to raise large amount of funds owing to the good quality of lectures, illustrated by practical demonstrations and lantern slides.[30] It may be mentioned that Sahni had reinforced his mission by the establishment of the Punjab Science Institute Workshop. However, there is no evidence to suggest that enthusiasm and interest in popular science, which Ruchi Ram Sahni had generated so assiduously, matured into a science movement in this region.

Another aspect of Ruchi Ram Sahni's contribution was to underline the positive role of regional languages in the dissemination of scientific knowledge among the masses. Despite the fact that perceptions of the educated elites in Punjab during 1880s had been influenced by the Brahmo leaders of the Bengal renaissance, they had increasingly turned to indigenous sources for inspiration and strength as the century drew to its close.[31] Hence, Punjabi was assigned a valuable role for social and intellectual regeneration. Ruchi Ram Sahni also preferred the use of Punjabi as a vehicle for scientific knowledge in his popular lectures. Judging by the response of his audience including average men and elites, Sahni concluded that mother tongue was the best medium to communicate modern science. It would enable the people to adapt scientific knowledge and technolgies to their environment and finally contribute to the development of alternate technologies. That the local languages were best suited to the fruitful dissemination of scientific knowledge among the masses was a deep-rooted conviction common among Indian intellectuals such as Raja Rammohan Roy, Master Ramchandra and his contemporary Sir Syed Ahmed Khan. There was a definite political agenda underlying the translation of the best European writings into Indian languages. Sir Syed Ahmed Khan pleaed that:[32]

> Those bent on improving and bettering India must remember that the only way of compassing this is by having the whole of arts and sciences translated into their languages.

The strongest argument in favour of the translation project was that the constant use of English language by impressionable children would not only habituate them to express their thoughts in it but also 'denationalise' them. Both Master Ramchandra and Ruchi Ram Sahni had expressed their anxious concern for the alienation of younger generation whose patriotic feelings ought to be nurtured. Both of them had actively contributed to the building of 'national character'.[33] While the former devoted his energy and talent to the translation of a number of European works on science in Urdu, the latter popularised information about latest inventions and various branches of scientific knowledge through his lectures in Punjabi, the most widely spoken language in this region.

Conclusion

A review of Ruchi Ram Sahni's contribution towards the spread of scientific awareness among the common people living in the urban areas (lecture-tours to villages being very few) draws our attention to three crucial issues (i) relationship between religion and science, (ii) tension between the practice of nationalism and cultivation of western science and technology, and (iii) conflict between the agenda of colonial science and needs/aspirations of the subject people.

The first issue concerning the nature of relationship between science and religion, also addressed in Europe in the last decades of the eighteenth century and first half of the nineteenth century, does not necessarily imply conflict, but a half-way meeting of two human initiatives (seemingly opposed) to maximise social progress, welfare and happiness. Both the scientist and the social reformer in colonial India had sought to achieve this shared objective through the pursuit of knowledge and scientific rationality. While the scientists of Ruchi Ram Sahni's generation were engaged in acquiring 'superior' and modern scientific knowledge and technologies for nation building, the social reformers had chosen to mediate the recovery and return to Upanishadic or Vedic knowledge. In their critique of Indian cultural tradition, social institutions and practices, religious codes and knowledge-systems as well as in their formulation of models and strategies for recasting society, economy and polity, impact of the West, particularly Comte's positivism, bourgeois values and concept of democracy, liberty, progress and modernity was obvious. Very often their roles overlapped. Both of them had used rationalism as a major argument for denuding Hinduism of its excrescences : idol-worship, superstitions, blind faith in demons' spirits, caste distinctions and

outdated religious rituals as well as for popularising western scientific knowledge and technologies.

Ruchi Ram Sahni, whose thought process had largely been influenced by the Brahmo intellectuals particularly Jagadish Bose and Prafulla Chandra Ray, had sought to resolve the conflict between the western scientific rationality and intuition-oriented Indian religions by turning to Brahmo Samaj. Without rejecting the need and support of religion, he practised rational theology. After joining Brahmo Samaj as a regular member, he had discarded the sacred thread—the cherished mark of a high caste orthodox Hindu. His commitment to rationalism was demonstrated when he had parted with his Brahmo mentor Shiv Narain Agnihotri because the latter indulged in self-glorification as a godman of sorts. Thus, scientific rationality had been used as a tool for bringing about socio-cultural change not only by Ruchi Ram Sahni but by the Brahmo ideologies generally.

The second issue concerning tension between the practice of nationalism and cultivation of Western scientific knowledge was viewed by the Brahmos from a different angle. For example, Jagadish Bose, who believed in Brahmo-inspired universalism, argued that knowledge was not the monopoly of any race and thus '....science is neither of the East nor of West but international'. Most of the Indian scientists sincerely believed that universalism and unity of knowledge were crucial to the growth of civilisation and common heritage of mankind. However, their bitter experiences as colonial subjects obliged them to confront the cultural chauvanism of the British imperialists who claimed scientific genius and achievements as the prerogative of the Anglo-Saxon races and behaved arrogantly. For example, Ruchi Ram Sahni has recounted the blatant form of racial discrimination against Indians in daily life. His personal experience of supersession in Educational Service in addition to the frequent humiliations as an individual not only angered him but also enabled him to evolve his own code of conduct to live with dignity.

Despite wilful denial of opportunities of training, professional growth and promotion by the colonial state, the national-minded scientists had neither boycotted scientific institutions and services nor honorific titles. They channelised their frustration and anger into more creative way like (i) creation of scientific awareness among adults and improving quality of science teaching in schools, (ii) opening of *swadeshi* chemical industries and scientific workshops, and (iii) translation of western scientific works into vernacular languages. These

three forms highlight the common trend of thinking–harnessing training and Western scientific knowledge for nation-building indirectly. It was an acknowledgement of the scientific achievements of the European nations and the keen desire of their colonial subjects to emulate them without abandoning their civilisation.

The third issue concerns the conflict between the agenda of colonial science and needs/aspirations of the Indian people. The colonial rulers perceived three potential roles for science. Its first role was concerned with exploration and discovery, the second with solving environmental and disease problems and the third with providing ongoing advice and technical services. All these roles targetted at making the colonies reproductive and at exploiting their potential in terms of human and natural resources as a tribute exacted from the hapless colonial subjects. Neither the development of the intellectual potentialities of the subject people nor economic modernisation of their country were on the agenda of the British rulers who had increasingly harnessed science and technology to holster the empire and capitalism. It was not only scientific education which was underdeveloped but research also. Factually speaking, training of Indians as qualified doctors, engineers and scientists was not a priority for the British rulers because these ranks were always available to metropolitan graduates in the biological and other sciences. Directed by the colonial-administrators-turned-ethnographers, the British officers in scientific institutions and services constantly used scientific means for social control with a view to perpetuating political hegemony. The statistical population surveys are a good example.

The foregoing discussion has shown that scientist like Ruchi Ram Sahni had been obliged to negotiate between the pulls and pressures of their intense desire to modernise their society through the instrumentality of Western scientific knowledge and the patriotic compulsion to fight for the defense of Indian cultural tradition and for national freedom. Despite role-conflicts and limited resources and space as a colonial subject, Ruchi Ram Sahni had tried to lay the foundation of modern scientific tradition through his campaign for popularisation of science. However, his pioneering initiative failed to mature into a science movement. Firstly, Ruchi Ram Sahni failed to train a team of students to continue either his task of popularisation of science or of improving quality of science teaching in schools. Those who were trained as scientists in this region were not farsighted enough to think beyond individual achievement. Secondly, the absence of large-scale industries also did not favour the growth of a science

movement. Thirdly, the colonial state was not interested in the development of science in this region. But on the whole the examples set by Ruchi Ram Sahni in Punjab were in line with the current of `limited modernisation' then passing in the local metropolis like Calcutta. India was gaining its cultural unity.

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Ruchi Ram Sahni : A Great Science Populariser of Punjab

H.S. Virk

When the British annexed Punjab after defeating the Khalsa Army of Maharaja Ranjit Singh in 1849, there was not even a single degree college teaching science in Punjab. Education was imparted through traditional system of *madarasas, pathshalas, chatsals* or religious seminaries set up in mosques, temples and gurdwaras. Oriental College, Lahore, was founded by the British in 1864 to teach Indian classical languages only. Teaching of science started during the late seventies when Government College, Lahore was established. It became the nucleus of Punjab University. Another degree college which introduced modern science was Mahendra College, Patiala, started in 1872. It was set up by Maharaja Mahendra Singh of Patiala State on the advice of his former tutor, and a great mathematician of Punjab, master Ramachandra. Mahendra College, Patiala, came up before Punjab University, Lahore and was consequently affiliated to Calcutta University for almost two decades. Since there was no tradition of teaching science in Punjab, all the teachers came from either Europe or Calcutta.

Another tradition which travelled from Bengal to Punjab along with European science was religious revivalism based on scientific rationality. The *Arya Samaj, Brahmo Samaj* and *Singh Sabha* movements in Punjab became the precursors of the introduction of modern European thought into this region. All of them started as religious revivalist movements, but their protagonists promoted the cause of modern European education in Punjab. By the end of the nineteenth century, Lahore, the capital of Punjab Province, could boast of better educational facilities and infrastructure for teaching science than Delhi, the future capital of India.

Ramachandra, a forerunner

Ramachandra was a forerunner of Ruchi Ram Sahni in certain respects. As a teacher of European science in Delhi College (now Zakir Hussain College), he translated books on mathematics and science into Urdu, under the aegis of the Vernacular Translation Society set up in 1843. On the initiative of Dr. Sprenger, Principal of Delhi College, Ramchandra started a weekly, *Qiran-us-Sadain*, in 1846. It carried articles on new

inventions, discoveries and research in modern science and technology in Urdu, the *lingua franca* of Punjab and northern India. The popular science writings of Ramachandra appeared in his journal *Fawaid-ul-Nazrin* between 1845-52. The topics pertained to algebra, geometry, astronomy, electricity and magnetism, philosophy and history of science. However, his most significant scientific work which established Ramachandra's reputation as a great mathematician was his original treatise 'On the Problems of Maxima and Minima'. Augustus de Morgan wrote the introduction and the book was published in London. Soon after his retirement from Delhi College in 1866, Ramachandra took up an assignment as a tutor to the Maharaja of Patiala. He was promoted as Director of Public Instruction and served the Patiala State till 1879.

Early life and education of Ruchi Ram Sahni

Ruchi Ram Sahni was born on 5 April, 1863 in Dera Ismail Khan, a small town and a riverine port on the Indus in Punjab. He got his early education in this town and stood first in his middle school examination. His father died and the family was in dire straits. However, Ruchi Ram did not lose heart and made up his mind to continue his studies. He gathered his books, covered a distance of nearly 250 km on foot, and got admission in the school of Adliwal near Jhang. He passed his high school examination from Lahore under the Calcutta Board, securing a position among the top ten. Ruchi Ram topped Punjab University in his BA examination which he took in 1884 from Government College Lahore.

Ruchi Ram got admission to the MA course in Government College, Lahore, and took up Physics and Chemistry as his subjects. He was deeply impressed and motivated by Prof. J.C. Oman, an experimentalist who built up the science departments. In the meantime, Ruchi Ram joined the Meteorological Department of India at Calcutta as Assistant Reporter. Prof. Oman advised him to complete his Master's degree in Presidency College, Culcutta, which had the excellent facilities for science education. Ruchi Ram got his training as Assistant Meteorologist, attended the required number of classes in Calcutta University, and took interest in the activities of Brahmo Samaj during his stay in Calcutta. He got a chance to meet and interact with top Indian scientists, like Prof. J.C. Bose, working in Presidency College . His interest in teaching and research got a boost while in Calcutta. Ruchi Ram served the Meteorological Department for two years under Sir H.F. Blanford in Simla, and prepared daily and monthly weather reports. Ruchi Ram was a very keen observer of atmospheric changes and made a remarkable

forecasting of a storm in the Bay of Bengal and saved many ships from destruction by sending a timely warning to all the sea ports in the region.

Ruchi Ram Sahni : A teacher and a scientist

Ruchi Ram left Simla in March 1887 and joined the Government College, Lahore, as Assistant Professor of Science. When Prof. J.C. Oman returned to England, he was given full charge of the Chemistry Department. He proved to be a dedicated teacher and prepared his lectures in advance and packed them with experimental demonstrations. In the beginning of this century Government College, Lahore, became an important centre for education and research in the chemical sciences in India.

Ruchi Ram helped poor but brilliant students in their pursuit of higher studies and research. Shanti Swaroop Bhatnagar (founder Director General of CSIR) was one of his favourite students at Lahore. Ruchi Ram managed to get him a scholarship to go abroad for doctoral research. Prof. Bhatnagar revolutionised the study of chemistry in Punjab University, Lahore, by introducing BSc (Hons.) and MSc (Hons.) classes in 1925. He was an eminent researcher who applied his scientific knowledge to solving the problems of industry. Thus, Punjab University, Lahore, became a leading centre of chemical education and research under his patronage.

Prof. Puran Singh, who trained at Tokyo University (1900-1903) in pharmaceutical chemistry, was another great chemist who encouraged the setting up of chemical industries in Punjab. He carried out original research as Imperial Chemist at the Forest Research Institute (FRI), Dehradun, on essential oils, tannins, drugs and pharmaceuticals. He introduced the cultivation of eucalyptus and 'Rosha grass' in Punjab. A friend of Sir C.V. Raman and a follower of Swami Rama Tirath, Puran Singh ended up as a great mystic poet of Punjab. His writings were replete with scientific terms.

Racial discrimination has been one of the main reasons for the absence of Indians in the top echelons of professional hierarchy in government services. The Government College in Lahore was not an exception. The Head of the Chemistry Department Prof. Jones, became quite envious of Ruchi Ram's popularity and tried to insult him on the slightest pretext. He even challenged Ruchi Ram to a teaching competition. When his challenge was accepted Prof. Jones withdrew. Ruchi Ram was a man of courage and conviction and never took things lying down.

When the situation became unbearable, Ruchi Ram decided to resign his post at the Government College. His initial plan than to set up some chemical works in Punjab, much on the pattern of P.C. Ray's Bengal Chemicals. However, it did not work out. In the beginning of 1914, he left for Europe to conduct investigations in the emerging field of radioactivity. His destination was in Germany, where he worked in the laboratory of Dr. Kasimir Fajans, an authority in the field of radioactivity.. While interviewing Ruchi Ram, Dr. Fajan remarked that both of them were working on the same hypothesis. Dr. Fajan had solved the problem of finding the correct atomic weight of lead and he suggested to Ruchi Ram to work on the problem relating to bismuth. Ruchi Ram found the atmosphere at the institute congenial and inspiring for research. However, before he could reach some conclusion, the First World War started in Europe and he had to flee to England for his safety.

In England, Ruchi Ram worked in the laboratory of world renowned nuclear physicist, Lord Ernest Rutherford, at Manchester. Neils Bohr, another giant in the field, was his research colleague. He published two research papers on the scattering of alpha particles in photographic emulsions. With the situation in war-ravaged England becoming critical, Ruchi Ram returned to India. On reaching Bombay, he found that the packet of emulsion plates had got destroyed in the ship during transit. He was unable to continue his research investigations at Lahore and thus a brilliant scientific research career came to an end.

Ruchi Ram as a science populariser

Ruchi Ram's major intellectual investment, apart from his research activities in Germany and England, was to translate science in the language of common populace. In this mission he was inspired by the efforts of his contemporaries in Calcutta who had already drafted plans for an institutional umbrella for science popularisation. During his Calcutta posting, Ruchi Ram got the chance to study the functioning of the Indian Association for the Cultivation of Science (IACS) set up by Mahendralal Sircar. Back home, he joined hands with Prof. J.C. Oman to found a similar organisation in Lahore. Thus came the Punjab Science Institute with Sahni as Joint Secretary. He took full charge of its activities after Prof. Oman left for England. The original aim and object of PSI was the popularisation of all kinds of scientific knowledge throughout the Punjab by means of lectures illustrated with experiments and lantern slides, as well as the publication of tracts. Subsequently, encouragement of technical education and setting up of chemical industries in Punjab were also included. Pamphlets on the manufacture of soap, indigo and other

products of common use were written and circulated. Cash prizes for writing short papers and pamphlets were also offered.

Prof. Oman delivered several lectures on electricity and magnetism. Dr. C.C. Caleb of the Medical College dealt with the human body and common diseases. Dr. Grant was a gifted speaker and embellished his lectures with charts, illustrations and projections.

Ruchi Ram started his popular science lecture series in 1886 while being posted at Simla, and the theme was weather forecasting. His popular science lectures, under the aegis of Punjab Science Institute, generated immense interest throughout the Punjab province (its boundaries extended from Delhi to Peshwar and included present-day Haryana, Himachal Pradesh and the Pakistani Punjab). PSI received requests from all corners of the province to send lecturers. It even decided to charge a small entrance fee ranging from one to two annas (nearly 10 np) to cover at least part of the expenses incurred in sending out lecturers, generally accompanied by laboratory assistants and the necessary apparatus to illustrate the lecture. In 90 per cent of the cases, it was Ruchi Ram who was called upon to respond to these requests for popular lectures. He had delivered so many lectures in Lahore and in other towns of Punjab that he was never at a loss for a topic or the appropriate apparatus to illustrate it. According to a rough estimate, Ruchi Ram must have delivered some 500 such popular lectures in Punjab.

His popular lectures covered a wide spectrum of themes, including everyday subjects such as 'Soap-making', 'The Water Lahoris Drank before 1880', 'Pure and Impure Air', 'Electricity in the Service of Man', 'Electroplating', 'Glass-making', 'How does the Telegraph Speak', 'The Punjab and its Rivers' (illustrated by a large relief map made in clay), and so on. The most interesting feature of these popular science lectures was the audience which consisted of both rural folk and city dwellers, mainly shopkeepers with just a sprinkling of English-speaking clerks working in offices. These lectures were not delivered in any special theatre or auditorium. Ruchi Ram used the compound of the Baoli Sahib Gurdwara in Lahore to deliver an annual course of some twenty lectures in Punjabi language to the general public. Popular science lectures were also organised in mofussil towns and villages on the occasion of festivals and fairs in open pandals. In order to attract rural folk, an element of theatricality was introduced and a nominal fee was collected on the spot after the show. Whenever Ruchi Ram found himself searching for an appropriate Punjabi word or expression for a technical term,

someone from the audience came to his rescue by providing an equivalent term already in common usage in the local dialect. Thus an unwritten dictionary of technical terms was created in Punjabi.

These lectures created so much enthusiasm and interest in the study of science that by the end of the nineteenth century, the number of schools teaching elementary physics and chemistry in Punjab was more than in any other province of India. This expansion of science teaching further opened new vistas for an innovator mind like Sahni. He had realised quite early that 'no science teaching in the province was possible without the provision of ordinary facilities for the repairs of simple school apparatus.' Despite financial constraints, he went ahead with his mission and established the PSI workshop in 1888 in a corner of his house. He engaged a railway workshop *mistri* (technician), Allah Bakhsh, on part-time basis. The simple items he forged were sold to schools at cost price, or even less, to promote experimental skills among students and teachers. The incipient workshop soon grew into a full-fledged manufacturing unit for locks and safes and scientific equipment of high precision. He appointed Allah Bakhsh on full-time basis as workshop assistant and put a lathe machine at his disposal.

The reputation of the PSI workshop grew to such an extent that Ruchi Ram received invitations from all over India to participate and display his scientific equipment at industrial exhibitions. At the 1906 Calcutta Industrial Exhibition, the PSI workshop was awarded a Gold Medal for the section on scientific exhibits by a panel of judges, which included J.C. Bose. The equipment produced in the workshop cost less than half the price of imported equipment. When the financial position improved, Ruchi Ram could afford to gift simple apparatus to schools and colleges in Punjab.

Other Facets of Ruchi Ram

Ruchi Ram's mission of science popularisation was inspired by an overwhelming desire to remove the social evils then prevailing in Punjab. He was thus a social reformer at heart. On his return from Germany, Ruchi Ram actively participated in the political and social movements of Punjab. After his retirement as a senior Professor of Chemistry from Government College, Lahore in April 1918, he fully immersed himself in the freedom struggle. He was deputed by Mahatma Gandhi to visit *Guru Ka Bagh* Morcha (Amritsar district) in 1921 where the brave Sikhs offered non-violent resistance to the British and won the battle for possession of the Gurudwara. Ruchi Ram became so involved in the

Sikh affairs of his time that he gave an eyewitness account of the Sikh struggle for the liberation of their religious shrines in his well-documented work *Gurdwara Reform Movement.* He was a founder trustee of *The Tribune* which started publication from Lahore, as well as a founder member of Dyal Singh College and Library. Though an agnostic, he participated in the *kar sewa* (voluntary cleaning operation) of the Golden Temple Sarovar (Holy tank). Punjab owes much to Ruchi Ram who introduced scientific temper and culture in the vanquished Punjab of the Khalsa Raj.

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Munshi Zakaullah and the Vernacularisation of Science in Nineteenth Century India

S. Irfan Habib

While examining science popularisation in the local languages, one should keep in mind that the vernacularisation of science in nineteenth century India was not merely a popular science activity. More importantly, its aim was to produce a corpus of literature on modern science, through translation as well as original writings. The mid-nineteenth century was a period when a large number of autodidacts initiated a dialogue through the translation of textbooks of modern science into the vernaculars. These autodidacts were intellectuals who were placed within the indigenous knowledge system but were pedagogically exposed to modernity. They launched a crusade for teaching science in schools in the local languages. Today, after about 150 years since Macaulay and the Comprador Indian Anglicists took over, the grip of English, particularly over science teaching, is so firm and complete, that science in the vernaculars is merely considered to be popular science activity, especially in North India. I will attempt to locate this activity through the contributions of Munshi Zakaullah, a mid-nineteenth century intellectual and pedagogue belonging to Delhi.

Munshi Zakaullah (for a short biographical sketch, see Appendix 1.1), was one of the leading exponents of teaching in the local language. He was a science teacher and mathematician, a social commentator, and also a historian of some repute. He was one of the favourite students of Master Ramchandra[1] at Delhi College in the fifties of the nineteenth century. Zakaullah had been a familiar figure for scholars of Urdu literature and journalism as he was one of the pillars of the 'Delhi Renaissance'[2] which saw the transformation of Urdu as a vehicle for the transmission of modern scientific and social ideas. However, his popular writings on science (carried in various contemporary journals like *Tehzib-ul-Akhlaq, Scientific Gazette, Aligarh Institute Gazette, Al-Nazir, Mohsin-ul-Akhlaq, Shams* and many others), his translation of scientific works from English to Urdu, and his efforts at promoting the teaching of science in the vernaculars have hardly received attention. This paper will try to remedy this by highlighting the contribution of Zakaullah.

Zakaullah and colonialism

The nineteenth century was a period of critical evaluation and introspection for most Indian intellectuals, who were exposed to the philosophy of European Enlightenment through the British colonial expansion. The reaction to this stream of thinking essentially took three forms. The first was complete Westernisation, where traditional learning was considered to be totally irrelevant.The second manifestation was revivalism, in which even modern scientific developments were telescoped into the past.The last and most balanced response was of revitalisation, according to which traditional knowledge needed to be resuscitated and strengthened, wherever necessary, with the help of modern knowledge.[3] Zakaullah belongs to the last category. Being a man deeply rooted in indigenous culture of Delhi, he revered this tradition in part, but simultaneously was convinced of the possibility of a bright future if a modern outlook was to be systematically cultivated. His position is sufficiently explicit in the following lines:

> I believe that it is ignorance to dub the ancient sciences or the Eastern sciences as irrelevant. And this ignorance is further compounded if the modern Western sciences are not preferred over the ancient or Eastern sciences. The truth is that the light of Eastern sciences is surrounded by an ever increasing darkness. But, being our own, this light gives us pleasure and its darkness is soothing. Comparatively darkness around the light of Western sciences is much less. Yet it dazzles our eyes and it is so alien, that we are unable to see anything else. We need to be accustomed to this light. Once this happens, we will be able to witness the splendours of nature and the miracles of human ingenuity.[4]

Most of the intellectuals of nineteenth century India were passing through a phase of transition where the past was invoked for 'historical guidelines in their heritage appropriate to society in transition'. They had to confront a vibrant European culture which had gone through tremendous socio-cultural and material changes during the preceding three centuries. Among all the European achievements, science and its marvels occupied the centre stage in imagination of Indian intellectuals. Zakaullah too was awed by these developments and was inclined to privilege the contemporaneous advancements in scientific knowledge over past accomplishments. In admiration for this period, he wrote:

> The nineteenth century had been an auspicious century because the Euro-Americans, through their inventions and innovations, and borrowings from the arts and crafts of their predecessors, had made unprecedented progress.

> Such a development we have not witnessed or even dreamt of in any other century.[5]

Here he seems to be voicing the global nineteenth century view *that this century had been the greatest landmark in the history of human progress. He was convinced* that 'without a full acceptance of the results of modern science and a full knowledge of them also, the East must inevitably fall behind the West, and the door of all future progress be closed.'[6]

Zakaullah and other cultural figures of North India, like Ghalib and Altaf Husain Hali, acknowledged the achievements of modern Europe, particularly its scientific and technological advancements. Hali, in his *'Musaddas'* pointedly referred to the fact that the results of Western science and art have been evident in India for the past hundred years. But, he believed that prejudice had veiled our sight, so that we could not see the radiance of the truth. Thus the dominant critique was a result of the exposure of the Indian intelligentsia to Western ways and Western learning through whose eyes the native Indian would have appeared aberrant.[7] Hali, commenting upon the prevalent understanding wrote:

> The opinions of the ancient Greeks are engraved upon our minds, now if truth were revealed from heaven we would not believe it. Those who cling fast to that philosophy today, who sing the praises of Avicenna's *Shifa* and the *Almagest*, lay their foreheads on Aristotle's threshold, and follow blindly in Plato's footsteps, are no whit better than the oxen at the oil press who spend their lives walking round and round, and finish up where they began.[8]

Syed Ahmad Khan also spoke emphatically against scholasticism and blind faith in ancient beliefs. He questioned the prevalent belief in Aristotelian philosophy and called for its subversion by pointing out that 'Aristotle was not our religious leader that we should consider his philosophy and metaphysics as infallible...'

Being a close associate and confidant of Syed Ahmad, Zakaullah agreed with him on the question of transcendence, where modern developments in sciences have to be given precedence over scholastic beliefs.

Moreover, Zakaullah had internalised the ideology of scientism which had been gaining ground in Europe since the seventeenth century. Expressing his commitment, he wrote: 'Science is that knowledge which has truth, an absolute truth and nothing but the truth.'[9] This scientism, which was reflected in most of Zakaullah's

writings, clashed with the narrow minded, tradition bound ideas of the East.[10] To keep abreast with the changing times, he advised people to look at ideas and facts through the prism of reason while simulataneously continue to respect their tradition.[11] He contested the general contempt heaped on new values because, according to him, blind faith in conventions takes one away from the realisation of truth. What did he mean by truth? For him, all modern Western knowledge was truth, particularly science, is a living example of his commitment to scientism. (Rafat Jamal, Zakaullah's biographer, had called this '*Aqliyat*' in Urdu, which means rationalism).

Looking beyond colonialism

Zakaullah was not sufficiently critical of colonialism or we may say, he was unable to perceive its implications critically in those times. Despite this inability, he could look beyond the colonial educational policy, which was not concerned with how best Indians could be educated but primarily with the inculcation of imperial ideology. Colonial rule was maintained not merely through administrative control but also by the mindset created by ideological influences. 'While struggling against the ideological influences of this system, to which they were strongly exposed, the Indian intellectuals also strove to formulate and implement an alternative based on science and mass education through the medium of vernacular languages.'[12] Moreover, Zakaullah, like others, was conscious of 'the inadequacy of the traditional and literary education to meet the needs of the time'.[13] Though he could not be sufficiently critical of colonialism, yet he committed himself to the cause of education in the vernaculars, which was contrary to Macaulayan Anglicism.

While Zakaullah was trying to look beyond colonial educational policy by his advocacy of the vernacular medium, the Anglicists were striving towards a more practical objective of producing brown *sahibs*. It is clearly spelt out in Macaulay's oft quoted words: 'Indians in blood and colour but Europeans in taste and manners'. The colonial educational policy was heavily tilted towards literary rather than scientific education. With the increase in the demand for trained manpower, some of the science courses were introduced 'merely to provide training in various branches rather than creating an appreciation of science as a tool of intellectual and social transformation.'[14] However, even these courses were problematic from the beginning itself because they were introduced in English. One was first required to master English, a long and tedious

process, almost impossible for some students and difficult for all. There is hardly any opportunity to awaken original thinking if education is to be imparted through a difficult foreign language, the genius of which was so widely different from that of the indigenous one. Zakaullah, thus, joined those who were striving to reverse this process by committing himself to vernacular educational ideals, producing adequate translations, and bringing out original writings in Urdu on science, mathematics, geography and other relevant subjects. He believed that education in foreign language meant sapping the mental capabilities of students.[15] He himself had learnt his science and mathematics through the medium of Urdu, as taught by Ramchandra, and he did not see why the younger generation should not do the same. For Ramchandra, such a possibility would not only facilitate the task of communicating this precious knowledge, but also enable Indians to work towards their own scientific achievements and contribute to the development of knowledge.[16]

Zakaullah did not merely espouse the cause of the vernacular, but was also actively engaged in producing books on science, mathematics and other subjects, be they translations from English into Urdu or original writings. His enthusiasm for Urdu in the late nineteenth century, when the Macaulyan Anglicism was dismissive of all such attempts, seems extraordinary. His early works, published by the Aligarh Scientific Society, dealt with chemistry, physics and other scientific subjects, as well as elementary and advanced mathematics.

As a colonial subject, exposed to the new knowledge and language, he was conscious of the weaknesses of Urdu as an acceptable medium of modern education. He knew that knowledge of English would ensure employment and social prestige under the colonial dispensation. Even Syed Ahmad Khan, who began as a staunch advocate of the vernaculars, shifted to Anglicism after his trip to England. The Aligarh Movement, which he launched, strove to establish MAO College as an Indian counterpart of Cambridge. Zakaullah's unflinching faith in modern education, particularly science, kept him involved with the movement, but he continued to believe in the efficacy of Urdu as the medium of instruction. He wrote several popular articles on science, nature, miracles and superstitions [17] and wrote thus about such writings:

> The way scholars in literature have found various ways of amusement through poetry, stories, fiction etc., similarly in the scientific world, the

> scholars keep writing such articles for people's amusement, which also flourishes (sic) their power of imagination and is not bogged down merely by empirical knowledge.[18]

Indian intellectuals in the latter half of the nineteenth century were conscious of the cultural and political implications of colonial education with English as the medium of instruction. They felt that this education undermined the process of nation building as it drew its inspirations from an alien culture and from a different historical experience. The *Tattabodhini Patrika* reflected this widely shared sentiment in one of the essays titled 'The Present Condition of Education':

> 'Our faculties would have developed freely and our national progress would have commenced, if our thoughts were not influenced by English. The books that are being prescribed in the schools and colleges are completely devoid of any national feeling...[19]

Even in Europe, according to Merz, the vernacularisation of science and literature, in the seventeenth and eighteenth centuries, had produced national 'spirits' or intellectual climates.[20] Latin and Greek were rejected as the languages of learning in favour of local languages, which enabled the people to participate in and identify themselves with the development of knowledge.

Zakaullah was in perfect conformity with the above viewpoint when he said:

> ....the constant use of English even from our childhood, so that we begin to express our thoughts in it instead of in our mother tongue, will go far to denationalize us. If we wish to remain an Eastern people, we must not neglect the language which we learnt at our mother's knee... To forget it, or to despise it, is to lose one of the strongest factors in the building up of national character.[21]

He formally began writing in 1851, though his first piece appeared in 1849. On an average, Zakaullah wrote around a thousand pages a year. By 1901 he had produced 146 books (for a representative list of books, see Appendix 1.2) in Urdu (including translations and original writings) on science, mathematics, history and literature. In all,— he published around 70,000 pages (he died in 1910). His first book on mathematics, called *Tuhfatul-Hisab*, appeared in 1852 and was widely acclaimed. Its first few copies sold out in three days.[22] This was one of the first books on modern Western mathematics to appear in any Indian language. Zakaullah himself writes about it:

> I may not be wrong if I claim that I wrote the first book of its kind in 1852 which had few hundred questions on mathematics. It became very popular and was published 15/20 times from different parts of the country.[23]

His biographer and friend, C.F. Andrews, also recorded this feat in the following words:

> Even while he was still a student, at the early age of seventeen, he had brought out his first mathematical work in Urdu. The Delhi people were greatly surprised and delighted at a mere lad undertaking such a difficult task, and the first edition was sold out in four days.[24]

Zakaullah went on to write a historical account, titled *Ajaib-ul-Hisab* of the development of mathematics from the earliest times to his day in Urdu. This was again one of the first books in this language on the history of mathematics which dealt with the contributions of Greeks, Romans, Arabs, Iranians and Hindus. Thus, Zakaullah laboured to produce as many books as possible in Urdu to establish that a local language can be transformed and modernised to communicate modern scientific knowledge. He used to say: 'I find myself by the riverside from where I see heaps of diamonds on the other side and wish I could bring them all here. This is what prompts me to translate books from English to Urdu'.[25]

He realised that the translation of scientific and technical literature was not an easy task, particularly that of developing an alternative terminology in Urdu for English terms. Nevertheless, he tried to resolve this dilemma and wrote thus about it:

> I have in my mind a number of methods and principles to develop new terminologies. But I decided to use one of these methods where if an English word is not difficult to pronounce I write it as such, but if the word is difficult then I use a word from our language which I find, is closest to the meaning. By all means I explain the English meaning in a simple language so that everyone can immediately follow it. Now I leave it to the reader to pronounce the English word wrongly or use their own language word correctly.[26]

Undoubtedly, his writings contributed to widening the vocabulary of Urdu and added to its vitality as a language. It was now imbued with the flavour of European ideas and philosophies, and it flowered as a language for the communication of science and other socially relevant issues. It was a significant transformation for a language associated till then with the 'decadent' Moghul court culture, known merely for poetic and rhetorical expression.

Concluding remarks

As this paper has attempted to show, Zakaullah's intellectual and pedagogic endeavours were a remarkable amalgam – they not only drew from the past but were also inspired by the present. Though firmly rooted in the indigenous culture, he was conscious of the modern challenges and the imperatives of transcending the traditional outlook. For him, this transformation was conceivable without disowning the past. An open and progressive approach meant for him an assimilation of modern scientific and technical knowledge. He was one among those intellectuals of the nineteenth century who took infinite pride in the achievements of the Indian civilisation, stretching back as it did to the Vedas and Upanishads. Yet he was the first to acknowledge that degeneration and decay had set in and the need for infusing fresh blood from outside. His commitment to modern science convinced him to give precedence to the present over the past. He was sure that it was impossible to envision a bright future without embracing modern knowledge, for mere tradition was not enough to facilitate the transition to modernity. For most nineteenth century intellectuals, this respect for India's past was reflected in a programme of cultural nationalism they advocated, which they felt was needed to regenerate the indigenous culture.

What prompted Zakaullah to espouse the cause of the vernaculars was this commitment to the past, besides his firm belief that a local language is the most effective means of communicating knowledge. He devoted his life to promoting and developing Urdu as an effective vehicle of modern scientific knowledge. Zakaullah hesitatingly accorded primacy to English over Urdu only when he found that people's aversion towards English is turning into some sort of a contempt for modern Western knowledge. He feared that such developments, if continued, would in the long run strengthen the forces of traditionalism and scholasticism. This situation impelled Zakaullah to join hands with Sir Syed in his movement for education and modernisation, even though he was aware that the later's Anglicism was contrary to his personal belief in the potential of local languages. Here Zakaullah was conscious of the need to strengthen the movement for modernisation which was being dubbed pejoratively as naturalism (*naicharya*) by its detractors. Syed Ahmad's programme was being vilified and condemned by the pan-Islamists like Jamaluddin Afghani, who wrote a treatise called *Al-Radd-al-Dahriya* (Refutation of Materialists) while in India in 1881.[27]

The post-Orientalist phase in the latter half of nineteenth century India had no relevance for the educational ideas of intellectuals like Zakaullah. Moreover, the intellectuals' dependence on the colonial state initiatives for the implementation of their programme made it a self-defeating exercise since it was distinctly different in its assumptions and purposes from the colonial education policy.[28]

In his last days, Zakaullah himself used to point to the number of volumes he had written, which were lying idle on the shelves, with no one to take them. Expressing his disillusionment, he would say that the tide had gone against him, and he had not been able to turn it back in the other direction.[29]

APENDIX 1.1

A brief biographical sketch

Munshi Zakaullah was born on 20 April 1832, in a house situated between the Great Mosque (Jama Masjid) and the Delhi Palace (the Red Fort). His family, since generations, was among the teachers of the Royal House of Timur. Zakaullah was the second child of Hafiz Mohammad Sanaullah. His father was the tutor of Mirza Kuckak Sultan, the youngest son of Emperor Bahadur Shah. His early education took place at home under the loving and able guidance of his grandfather Hafiz Mohammad Baqaullah. Baqaullah was very fond of his grandson, particularly for his sharpness as a young student. Once Zakaullah's mother wanted the grandfather to punish his grandson but Baqaullah refused, saying : 'No, No. The boy is so clever and had done his lessons so well, that I cannot have a heart to punish him for any fault he may have committed today.'

Zakaullah entered Delhi College at the age of twelve in 1844. It opened up for him a totally new world of knowledge and vision. He got particularly attracted towards two of his teachers–Imam Baksh Sahbai, professor of Persian, and Master Ramchandra, his teacher of modern science and mathematics. This, in a way, shaped Zakaullah's cultural and intellectual perceptions and concerns as well.

He developed special interests in mathematics and turned out to be the most brilliant and promising student of Ramchandra. A warm affection sprang up between the two. His proximity to and love for his teacher even led to unfortunate rumours that Zakaullah was about to follow his tutor's lead and openly profess himself a Christian. It never happened because their friendship was at an intellectual level, soley devoted to learning and the advancenent of knowledge. As a student at Delhi College,

Zakaullah became actively involved with the Vernacular Translation Society and translated many works from English to Urdu. Among his contemporaries at the College were men like Nazir Ahmad, Maulvi Karim Baksh, Pyare Lal Ashob, Chandu Lal, Kanhaiya Lal, Mir Babar Ali and Ziauddin. All of them became important cultural figures of Delhi.

The 1857 Revolt was a great political and cultural shock for Zakaullah and his family. He was under suspicion due to his association with his Christian convert teacher, Ramchandra. He spent most of this time working at home in private, completely avoiding any involvement in public affairs.

Zakaullah taught mathematics at Delhi College for sometime, then moved to Agra College as a Professor of Persian and Urdu. He later joined the Department of Education as Deputy Inspector of Schools in 1855. After serving for eleven years, he joined Delhi Normal School as its Head Master in 1866. In 1869 he accepted an offer to join Muir Central College, Allahabad, as Professor of Persian and Arabic, and after fifteen years finally retired from here in 1885. Even after retirement, he continued with his schedule of writing and translating books for schools. Nor did he give up the struggle for the vernacular medium of instruction and female education. In 1864 the British government rewarded his efforts to promote female education. In 1872 his contribution to the vernacular medium of instruction was also recognised.

Zakaullah's health was generally good on account of the very disciplined life he lived. He died in 1910 at the age of seventy eight.

APENDIX 1.2

Some publications of Zakaullah

Zakaullah was a prolific writer. He wrote and translated around 150 books. Given below is a select listing of his original writings:

A. **Mathematics**

1. *Tuhfat-ul-Hisab* (Delhi, 1852). This was the first book published by Zakaullah at an early age of nineteen. It dealt with modern mathematics based on questions and answers. The book was highly appreciated and the first edition was sold out in three days.
2. *Risala Masahat Mubtadiyon ke Liye* (A Book on Mensuration for Beginners, Delhi, 1881). This was a 160 page field book on mensuration, with questions, figures, and a number of illustrations to explain the problems.
3. *Risala Ilm-i-Masahat* (A Book on Mensuration, Delhi, 1871). This was again a book on mensuration written at the behest of the Aligarh

Scientific Society and also for the students of Thomson Civil Engineering College, Roorkee.

4. *Sharah Jabr-o-Muqabla* (A Book on Algebra, Delhi, 1873). This was a 150 page book on algebra contaning a number of questions and examples to explain the problems.
5. *Risala Masail Ma-adlat* (A Treatise on the Problems of Matter, Delhi, 1871). This book dealt with the problems of mechanics and dynamics as propounded by Newton, Descartes and others. Zakaullah himself called this work a "strange publication".
6. *Ilm-i-Musallas* (A Book on Trigonometry, Delhi, 1871).
7. *Risala Ilm-i-Jabr-o-Muqabla* (A Book on Algebra, Delhi, 1862).
8. *Ajaib-ul-Hisab* (A History of Mathematics, Delhi, n.d.). This was a book on the history of mathematics from the beginning till his own times. It dealt with the mathematics of Greeks, Arabs, Romans and Hindus.
9. *Zabani Hisab* (Mental Mathematics, Meerut, 1870).This was a 221 page book on mental mathematics, with particular emphasis on the skills of the Hindus for this subject.

B. History

10. *Tarikh-i-Hind* (A History of India). This was a voluminous work of Zakaullah, beginning from ancient Indian times to the consolidation of British rule in the nineteenth century. This was probably the first detailed historical account of India available in Urdu. The work was spread over 10 volumes, the first appearing in 1873 and the last in 1898. All of them were published from Delhi.
11. *Tarikh-Uruj-i-Sultanat-i-Englishia* (A History of the Rise of the British Empire). This was a five volume work on the emergence of the British Empire. The first volume appeared in 1904 from Delhi.
12. *Muharbat-i-Azim* (A History of the Great World Battles, Delhi, 1904).
13. *Curzon Nama* (An Account of Curzon's Reign, Delhi, 1907). Spread over 461 pages,this book dealt with the period of Curzon's Viceroyalty.

C. Geography

14. *Ilm-i-Geographia* (Geography, 1875). The book is a general geographical work, with special emphasis on the geography of India.
15. *Geographia-i-Tabai* (Physical Geography, Delhi, 1876). This 132-page book opens with an 18-page introduction. It refers to the change of seasons, phenomena of day and night, clouds, rains and snowfall etc.
16. *Geographia-i-Riyaziya* (Mathematical Geography, Delhi, 1884). This

book gives a description of the moon, rotation of the earth, cartography and the techniques of map-making, etc.

D. Morals and Culture

17. *Tahzib-ul-Akhlaq Arya Hind* (Morals and Culture of the Hindus, Delhi, 1890).
18. *Muhasin-ul-Akhlaq* (Laudable Morals, Delhi, 1891). This 720- page book borrows from various European works on morals and conduct. However, it also has a sprinkling of couplets from famous Persian poets and philosophers like Rumi and Nizami.
19. *Mukarram - ul - Akhla*q (Venerable Morals, Delhi, 1891).This is a 356-page book on morality and conduct as reflected in the Quran and Hadis.
20. *Ta-alim-ul-Akhlaq* (Moral Education, Delhi, 1892).

E. General Publications

21. *Sahifa-i-Fitrat* (A Book on Nature, Delhi 1894).This 640 page publication contains more than 300 figures to explain the various natural phenomena.
22. *Hikmat-ul-Mizan* (The Physical Sciences of the Muslims, Allahabad, n.d.).
23. *Char Ansar* (Four Elements, Delhi, 1979). A book on chemistry, it deals specifically with the characteristics of the four elements -air, water, fire and earth.
24. *Falsafa-i-Amsal-o-Muntakhab-ul-Misal* (A Book on Selected Aphorisms and Proverbs, Delhi, 1898). This is a 304 page book on famous proverbs and aphorisms from 27 Asian, European and African languages. It includes a total of 4365 proverbs.
25. *Gharbi Sharqi Tabiyat ki Abjadon par Mahakmat* (Discourses on the Beginnings of the Physical Sciences of the East and West, Delhi, 1900).
26. *Uloom-i-Tabiya ki Tarikh* (A History of the Physical Sciences, Delhi 1901).
27. *Uloom-i-Tabiya Sharqi ki Abjad* (Beginnings of the Physical Sciences of the East, Delhi, 1900).
28. *Musalmanon ke Uloom-i-Tabiya ki Tarikh* (A History of the Physical Sciences of the Muslims, Delhi, 1900).
29. *Science aur Mazhab ki Razm-o-Bazm* (On Science and Religion, Delhi, 1901).

Notes & References

1. Master Ramchandra was an important intellectual and cultural figure of mid-nineteenth century Delhi. He was a prolific writer, social commentator and a mathematician. For further details on Ramchandra, see S. Irfan Habib,and Dhruv Raina, 'The Introduction of Scientific Rationality into India: A Study of Master Ramchandra-Urdu Jounalist, Mathematician and Educationalist, *Annals of Science*, pp.46,1989; Dhruv Raina, S.Irfan Habib, Ramchandra's Treatise Through "The Haze of Golden Sunset" : An Aborted Pedagogy',*Social Studies of Science*, 20, 1990, pp.455-72.

2. Though a pale reflection of what was witnessed in Calcutta, the Delhi Renaissance saw some interesting intellectual and literary activity. Among the Delhi Renaissance we may count people like Master Ramchandra, Pyare Lal Ashob, Syed Ahmed Khan, Zakaullah, Altaf Husain Hali, Mohammad Husain Azad, Nazir Ahmad and several others.

3. S. Irfan Habib and Dhruv Raina, 'Copernicus, Columbus, Colonialism and the Role of Science in the Nineteenth Century India,' *Social scientist*, 17(3-4), 1989, pp.51-66

4. Zakaullah, *Uloom-Tabiya Gharbi Ki Abjad* (Beginnings of Western Physical Sciences), Delhi, 1900, pp.5-6.

5. *Ibid.* p.3.

6. C.F. Andrews, *Zakaullah of Delhi*, London, 1929, p.97.

7. S. Irfan Habib and Dhruv Raina, 'The Introduction of Scientific Rationality into India: A Study of Master Ramchandra -Urdu Journalist, Mathemitician and Educationalist, *Annals of Science*, 46, 1989, p.599.

8. Quoted in Aziz Ahmad and G.E. Von Grunebaum, *Muslim Self-Statement in India and Pakistan*, 1857-1968, Weisbadan, 1970, p.97.

9. Zakaullah, *Gharbi Sharqi Tabiyat Ki Abjadon par Mahakmat* (Beginnings of the Physical Sciences of the East and West), Delhi, 1900, p.19.

10. Rafat Jamal, *Zakaullah, Hayat aur unke ilmi wa Abadi Karname*, Delhi 1990. p. 172.

11. *Ibid*

12. K.N. Panikkar, 'Presidential Address, Indian History Congress', 36th Session, Aligarh, 1975, p.7.

13. *Ibid.*

14. Irfan Habib, 'Institutional Efforts: Popularisation of Science in the midnineteenth Century', *Fundamenta Scientie*, 6(4) 1985 p.300.

15. Zakaullah,'*Fanoos-i-Adab*', Delhi College Magazine, 1953, p.145.

16. Habib and Raina, 'Introduction of Scientific Rationality into India',*op.cit.*, note7, p.605.

17. Some of the popular articles published in various journals are: 'Strange Inventions',' Rainbow',' Wailing for Money', 'New Balloon,' Steam Engine and Printing', 'How to Spread Light in India', 'Indian Newspapers and the Government', 'Probabilities in Nature',' Why and Why not Should We Believe in Miracles',Excellence is Impossible without Perseverence,' and Rotation of Earth'.
18. *Yad-i-Baizah*, 1 April 1907.
19. *Tattabodhini Patrika*, Magh, 1798, Saka, No.402. Quoted in Panikkar, *op.cit.*, note 12, p.219.
20. John Theodore Merz, *History of European Thought in the nineteenth Century*, 4 volumes, 1896, quoted in Lewis Pyenson, 'Prerogatives of European Intellect: Historians of Science and the Promotion of Western Civilisation', *History of Science*, 31, Part 1, 1993.
21. Andrews, *op.cit.*, note 6, p.97.
22. Nawab Zainul Abidin Khan was one of the uncles of Sir Syed. His house was looked upon as a strange place of mathematical and astronomical learning, full of scientific instruments, with pulleys hanging from the roof. When he came to know about young Zakaullah's publication, he called him home and said, 'Well, young man, I hear that you are a second Euclid. I will give you three days to solve a mathematical problem for me.' Zakaullah returned after three days and said that the problem was insoluble because at the final stage it was necessary to do something geometrically which was impossible. The Nawab was greatly surprised and pleased, 'My dear lad,' he said, 'you have really solved the problem, because you have arrived at the final stage beyond which there is no solution.'
23. Zakaullah,*Intikhab-Mantahi-ul-Hisab*, Delhi, 1980. However, Zakaullah's own teacher Ramchandra had written a book on mathematics in Urdu called the *Sari-ul-Fahm*. It was a book on modern mathematics based on the mathematical riddles of Lilavati.
24. Andrews, *op.cit*, note 6, p.65
25. *Aligarh Magazine*, 1950, p.45
26. Zakaullah, *Kimiyae Daulat*, Delhi, 1900, p.7-8.
27. Adel A Ziadat, *Western Science in the Arab World*, London, 1986, p.85.
28. Panikkar, *op.cit.*,note 12.
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Popularisation of Science in Assam
Examples from Pre-Independent India

Bandita Phukan

The genesis of a sense of appreciation for science among the people of Assam during the pre-Independence era has been one of the most splendid episodes in regional history. Rather than any conserted effort from the colonial state the whole project was built on the participatory attitude of the local populace. Origin of this change in attitude can be traced to their first encounter with an alien culture. When the British influence reached the mighty Brahmaputra during the first half of the nineteenth century the minds of the people were laden with various superstitions and society was riddled with taboos. Communication by road was in a primitive state. The only effective means of transport being the clumsy river boats on the Brahmaputra. People lived in isolated groups with little intermixing among them. There was no newspaper till 1846. Also absent were formal schools, except for the age-old local institutions called *TOL*. The Ahoms, the pre-British rulers of Assam, were not entirely unmindful of the cause of education. But they had to devote much of their time to conquest, consolidation and warding off foreign aggressions. They promoted the teachings of Indian classics like *Mahabharata, Ramayana, Upanishads* etc. At some point, the study of arithmetic, medicine and astronomy was also added to the curriculum.

The signing of the treaty at Yandabu in Burma on 24 February 1826 was a landmark in the history of the whole north-east. It not only opened an otherwise closed hilly terrain for British political control but also caused a social and cultural transformation in the lives of the local tribes. While the climatic conditions of Assam invited the British speculators to invest in commercial crops like tea (which ultimately paved the way for certain technological projects in the region), the absence of a strong religious force encouraged the Christian missionaries to subvert the religious faith of the people through the medium of educational norms.

Tea was first discovered in Assam in 1823 by a British named C.A. Bruce. Tea plantations in Assam started commercial production in 1837 under the supervision of Bruce. On 23 March 1838, he sent

12 Assamese tea chests to London by ship from Calcutta. Plantations further opened the region for trading activities. In 1839 the Assam Company was formed in London to start tea plantations and trading of tea. The company employed steam ships for its cargo in 1841. The ship took 40 days to reach Dibrugarh from Calcutta by the Brahmaputra river. By the turn of the century the expansion of railway network was carried to the north-eastern regions. The Assam Railways and Trading Company was formed in July 1881. It was engaged in the mining and trading of coal and tea. Four months later four railway engineers arrived at Dibrugarh from Calcutta by ship, followed by a train engine. The first train was flagged off on 1 May 1882 which ran from Mohanghat to Jaipur. In addition to tea, mineral products from Assam also drew the attention of British investors. Oil was discovered in Upper Assam in 1867 by Subh Enaf belonging to the Assam Railways and Trading Company. In 1889, India's first oil refinery and the second in the world, was set up in Digboi.

However, such commercial investments in technological projects had a limited influence on local mind-set *vis-a-vis* science. These developments were confined to small pockets. Even the world's second refinery was operating in the remotest north eastern corner of the state with the result that people residing in other parts of the state were totally ignorant about it on account of poor communication means.

Promotion of education and science

As the British began to consolidate their rule, they felt the need for the creation of an educated class to serve and assist them in administration. Though the colonial state did not take the job upon itself, they encouraged the establishment of schools by private agencies including Christian missionaries and trading companies. On their part the Christian missionaries considered education to be a very effective mode of promoting Christian faith. Besides, they were also aware of the fact that in order to get the message across to the common people, they would have to master the local language. They, therefore, started learning Assamese in earnest. As a result of these endeavors, the Bible was translated into Assamese and published in 1813. This was the first book to be published in the Assamese language. In 1831, Adam White, a Christian missionary, established an additional school at Guwahati, in collaboration with Mr. Roe. On 23 March 1836, two American Baptists, Dr. Nathan Brown and O.T. Cutter, arrived in Sadia, a small town in the eastern-most part of Assam. The first Assamese-medium school was started in Sadia by

Ms. Brown and Ms. Cutter in the later part of 1836. By 1844, the American Baptist missionaries, under Rev. O.T. Cutter, had set up 14 Assamese-medium schools in Sibsagar district. The Welsh missionaries established half a dozen schools in 1853.

In addition to the Christian missionaries some representatives of private trading companies also came forward to promote educational activities in Assam. Dr. John Bery White was a doctor in the Bengal Army and one of the directors of the Assam Railways and Trading Company. He donated a major part of his earning to the government to help establish a medical school. Thus in 1889-99, the Bery White Medical School was set up in Dibrugarh during the tenure of Sir Henry John Stedman Cotton, the then Chief Commissioner of Assam.

State initiatives in education came at a halting rate, first through the agency of district administrators. For example David Scott, Governor General's Agent stationed in the North East Frontier, obtained government approval in October 1826 for allotting land to set up *toles*. Accordingly, 11 schools were set up, mostly in Lower Assam. Towards the end of 1835, the first English medium school, Guwahati School, was started, making the beginning of higher secondary education in Assam. The subjects taught in junior classes included Wilson's Chronology, Yates' Elements of Natural Philosophy, English grammar, the use of globes, arithmetic with translation and composition. The curriculum of the senior classes consisted of Marsman's History of India, Homer's Illiad by Pope, Elements of Natural Philosophy, geography, arithmetic up to vulgar fractions, composition and translations, etc.

In 1864, the Guwahati English School (later Collegiate School) was affiliated to the Entrance Standard of Calcutta University with Bengali as the medium of instruction. Like English, Bengali was just like another foreign language for the Assamese students. It too hampered the process of learning and creative thinking. Widespread discontent prevailed on account of this, with a number of public representations being made. Finally in 1873, in deferrence to the people's wishes and the recommendations of high officials, like A.J. Moffalt Mills, Judge of the Safar Dewani and Nizamad Adawalt etc., the Lieutenant Governor declared that Assamese would replace the Bengali as the language of the schools and courts of Assam. The Inspector of Schools was directed to take necessary steps for the introduction of Assamese as the medium of instruction. Prizes were declared to encourage the preparation of suitable books in Assamese.

Role of the Cotton College

Apparently the British did not take the educational level of the state to any great heights during the first half of the nineteenth century. This was mainly an account of their sole intention of developing a supporting class to assist them in administrative matters only. The imperial government showed no genuine interest in the dissemination of education and science for the upliftment of the people. Since 1862, regular public representations had been made for establishing a college at Guwahati. The strongest support came from the then Chief Commissioner, Sir Henry John Stedman Cotton. Government sanction for setting up a college in Guwahati was received on the 20 June 1890. The Chief Commissioner formally opened the college on the 27 May 1901 under the curriculum of Calcutta University.

The first principal of the Cotton College was Mr. F.W. Sudemerson. In 1909 another building was added to Cotton College, with four rooms for conducting practical classes in physics and another four for chemistry practical classes. A darkroom, an optical room, and a lecture-theater for physics were also provided in the same block. In 1927 intermediate classes in botany were started. Further expansion of the scientific curriculum did not occur till 1939-40 when biology was added. In 1940-41 botany was introduced in the pass course degree classes and in the same year zoology was introduced in the intermediate science classes.

As for the science faculty at the college initially the teaching community was drawn from the European ranks. But gradually the local elites made their entry. In July 1908 Babu Surendra Nath Chatterjee joined Cotton College as Lecturer in Physics, followed by Babu Ananda Kishore Das as Demonstrator in Chemistry in January 1909. In August 1910, Babu Haridas Bagchi, Professor of Mathematics joined the College, followed by Dr. David Thomson, Professor of Chemistry, in February 1911. Separated from the mainland the staff of the Cotton College was not expected to do much of original research. This has been succinctly stated by Dr. David Thomson, the Principal of Cotton College, (1926-33):

> Isolated as we are here and with very heavy teaching and administrative duties and only a moderate library facilities, worth-while research is far from easy. All the more credit therefore is due to those members of staff who succeeded in doing something to extend the boundaries of knowledge in their subjects despite their grave handicaps.

But the college provided a platform to science popularising

activities through popular lectures, demonstrations and exhibitions. In December 1941, the college organised a science exhibition at the War Fund Mela for the purpose of raising money for the War.

Communicating Science: The Role of Magazines

The genesis of popular magazines, both literary and scientific, in Assam is linked with the missionary endeavours. It has been acknowledged by Dr. Maheswar Neogi, a renowned Assamese scholar, that in the nineteenth century, when modern means such as telegraph and railways were not available in India for the communication and dissemination of current news, these missionaries, despite being in a remote corner of the country, did a commendable job. They endeavored to spread news from all corners of the globe among the people of Assam through the *Orunodoi*, the first Assamese newspaper-cum-magazine, started in January 1846 at the Sibsagar Mission Press. In its first issue, it introduced itself as a monthly paper devoted, among others, to religion, science and general intelligence. The *Orunodoi* survived for nine years from 1846 to 1854. In this regard, the missionaries were greatly helped by an young Assamese officer, Anandaram Dhekiyal Phukan. The fact that *Orunodoi* was devoted to science and general intelligence is of great importance as its pages went a long way 'to extend the intellectual horizon of the readers'.

The *Orunodoi* explained global geography. Apart from the physical description of many foreign countries, political accounts as well as historical backgrounds were also attended to. The magazine also published many scientific articles dealing with the solar and lunar eclipse as well as the night sky with its stars and planets, accompanied by elaborate sketches. News about scientific inventions like the printing machine, telegraph, glass-making technique, were prominently published on the pages of the *Orunodoi* in simple Assamese so that these subjects could easily be comprehensible to its readers. Of course, there were regular pages in the *Orunodoi* about the many stories and morals of the Christian religion. But there is no doubt that the *Orunodoi* actually helped its readers to open up their minds to modern modes of thinking.

In addition to the *Orunodoi*, a front magazine of the missionaries, the students from Assam then studying in Calcutta also launched *Jonaki*, a monthly magazine. Started in January 1889 it carried articles, short stories, poems, etc., written by many renowned writers of Assam in Assamese. Chandrakumar Agarwala, the first editor of *Jonaki*, laid

stress on publishing science-based articles in his magazine. He wrote in his editorial that the Assamese people will remain backward compared to their fellow citizens if they remain uninformed in this modern era about the steamship, rail engine, telegraph, etc.

With a view to popularise science among the common people, Hemchandra Goswami requested Rajanikanta Bordoloi, then studying in medical school in Calcutta and who later became a famous novelist in Assam, to write some science-based articles for the *Jonaki*. Thus, Bordoloi wrote *Sarir Tatta* (Physiology of the Human Body), the first science-based article in an Assamese magazine. It was carried in the seventh, eighth and ninth issues of its inaugural volume. The language and examples cited in this article were extremely simple and easy to understand. The second science based article titled "The Rule Followed in the Birth of Plant and Trees" in *Jonaki* was also written by Rajani Kanta Bordoloi.

During its second year of publication, renowned writers like Upendranath Barua also started to contribute science - based articles. The subjects of two of his articles were simple and related to water, earthquakes, etc. They appeared in the eighth and twelfth issues of *Jonaki*. By the time it entered its third year, another renowned writer, Kanaklal Barua, wrote some commerce and industry-based articles. A lady writer, Jajneswari Barkakati, also contributed science-based articles, "Physical Labour" to the fifth issue and 'Flower' to the tenth issue. In the sixth issue of the same year, Ananda Chandra Gupta (Agarwal) wrote an article `Early Rising' where he described the many ways of approaching health care. The eleventh and twelfth issues carried a two-part article, 'Air', by Chandradhar Barua. From the fifth issue of the third year, the then editor, Kanaklal Barua, tried to give news about modern scientific inventions as well as discoveries. These included the description of unburnable house in the city of Hamburg in Germany, a kind of car driven by a steam engine, medicine for a scorpion's bite, a wonderful clock driven by light from the sun, the scientific inventions made by renowned scientist Tomas Alva Edison and health care assorted methods. In its fourth year of publication, *Jonaki* carried five science-based articles and other news items. In the second and third issues of the fifth year, Kanaklal Barua wrote two articles `Usefulness of Earthquakes' and `Evolution'. In the sixth year's second issue of *Jonaki*, the article on telephone by Bijoy Ram Barua was published. In the same year's eleventh issue Saiffuddin Ahmed wrote an article on the `Usefulness of Plants & Trees'.

This, then, is the sum total of the various endeavours undertaken to popularise science in Assam in the pre-Independence period. In terms of concrete achievements, perhaps, the efforts did not match those made in other parts of India. Yet one can not fail to appreciate the spirit and zeal of all those enterprising persons who tried their best to popularise science in the face of severe constraints, like geographical remoteness, poor communication facilities, lack of infrastructure for research work, etc.

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